SURVEY PRO

for Windows® CE

User's Manual

.MAN-CESURVEYPRO **07192001**

Table of Contents

Getting Started

TDS Survey Pro for Windows CE is available with different options and sold under the names, **Survey Standard**, **Survey Pro**, **Survey Pro Robotic**, **Survey Pro GPS**, and **Survey Pro Max**. Throughout the manual and software, it is simply called Survey Pro. For a listing of which features are included in each product, contact your local TDS dealer.

This manual covers the routines that are available in all of the different software packages except for the GPS routines, which are included with Survey Pro GPS and Survey Pro Max. The GPS routines are covered in a separate manual.

Manual Conventions

Throughout the Survey Pro Manual, certain text formatting is used that represents different parts of the software. The formatting used in the manual is explained below.

Fields

When referring to a particular field, the Field Label, or its Corresponding Value is shown with text that is similar to what you would see in the software.

Screens and Menus

When referring to a particular screen or menu, the text is <u>underlined</u>.

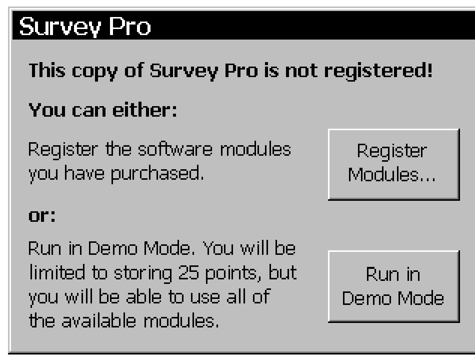
Buttons

When referring to a particular button, the text is shown in a Button Format, similar to that found in the software.

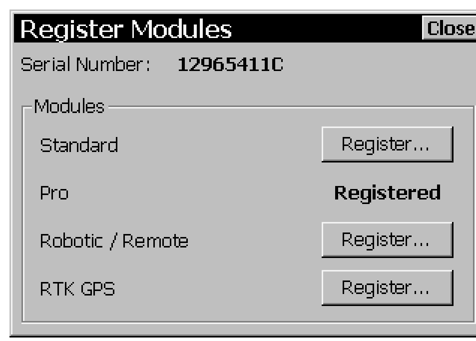
Installation and Upgrading

The Survey software that you purchased is shipped pre-installed on the data collector. Upgrading the software is simply a matter of purchasing a registration code that is specifically generated for your data collector. Once entered in the data collector, it will activate the appropriate add-on module.

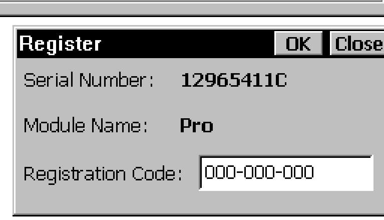
If you start Survey Pro and the Standard Module has not yet been registered, the first screen shown here will open. If you select the Register Modules button, you will access the Register Modules screen, described next. If you select the Run In Demo Mode button, the software will run in demo mode. When running in this special mode, all areas of the software are available. The only limitation is, a job cannot exceed 25 points. If a job is stored on the data collector that exceeds this limit, it cannot be opened.



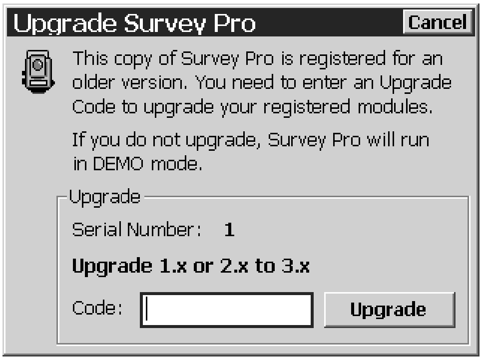
Add-on modules can be purchased from your local TDS dealer to upgrade your TDS Survey Software. Upgrading is a quick and easy process and described below.



1. On the data collector, tap 1 File, G Register Modules from the Main Menu.
2. Contact your TDS Dealer and give him your unique serial number that is displayed on your screen. He will give you a registration number for the module that you purchased.
3. Tap the Register... button for the appropriate module, enter the registration number in the dialog box that opens and tap OK. All the features for the module that you purchased will now be available.



Note: You should keep a record of all registration codes purchased in case they need to be reentered at some point.



Upgrading from Version 1.x or 2.x to Version 3.0 or later is a chargeable upgrade. Once the new software is installed, the screen shown here will be displayed. A new registration code must be purchased and entered in the Code field or the software will only run in Demo Mode, as described above. Only one upgrade code is required to upgrade all of the earlier-version modules that were previously registered.

Users that are upgrading to Version 3.0 or later from Version 1.x or 2.x must consider the following limitations before installing the new software:

- You should have a Ranger with at least 32-MB of onboard memory. The 16-MB models are not sufficient to run the program and store a large job.
- The Ranger must have Version 2.1 or later of Windows CE installed before installing the new Survey Pro software.

Angle and Time Conventions

Throughout the software, the following conventions are followed when inputting or outputting angles and time:

Azimuths

Azimuths are entered in degree-minutes-seconds format and are represented as DD.MMSSsss, where:

- DD One or more digits representing the degrees.
- MM Two digits representing the minutes.
- SS Two digits representing the seconds.
- sss Zero or more digits representing the decimal fraction part of the seconds.

For example, 212.5800 would indicate 212 degrees, 58 minutes, 0 seconds.

Bearings

Bearings can be entered in either of the following formats:

- S32.5800W to indicate South 32 degrees, 58 minutes, 0 seconds West.
- 3 32.5800 to indicate 32 degrees, 58 minutes, 0 seconds in quadrant 3.

Time

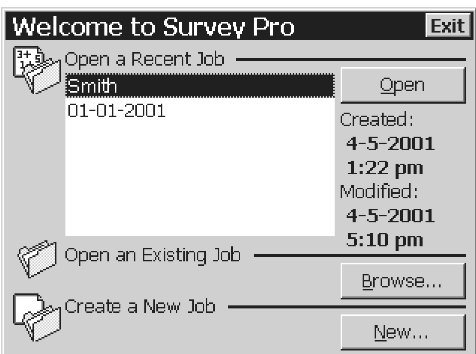
When a field accepts a time for its input, the time is entered in hours-minutes-seconds format, which is represented as HH.MMSSsss where:

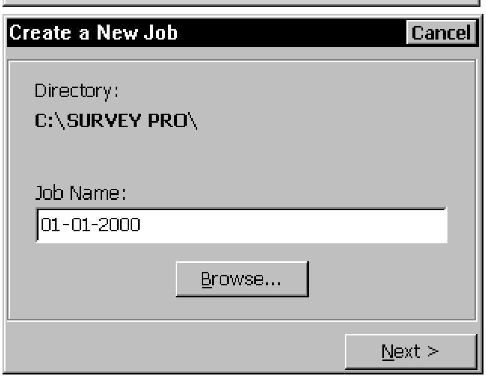
- HH One or more digits representing the hours.
- MM Two digits representing the minutes.
- SS Two digits representing the seconds.
- sss Zero or more digits representing the decimal fraction part of the seconds.

Starting the Program and Creating a New Job

Since Survey Pro runs in the Windows CE operating system, selections and cursor control can be made by simply tapping the screen with your finger or a stylus.

You can start the Survey Pro program by double tapping the  icon located on the desktop.



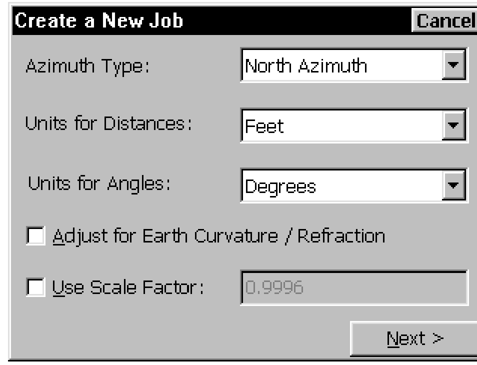


Survey Pro cannot start without a job being open so the Welcome to Survey Pro screen will ask if you want to open a recently opened job, open an existing job, or create a new job. For this example we will create a new job so you can begin exploring the software.

1. Tap the New... button. The Create a New Job dialog box will open, which prompts you for a job name where the current date is the default name.

2. Either type in a new name or accept the default name and tap Next > to continue.

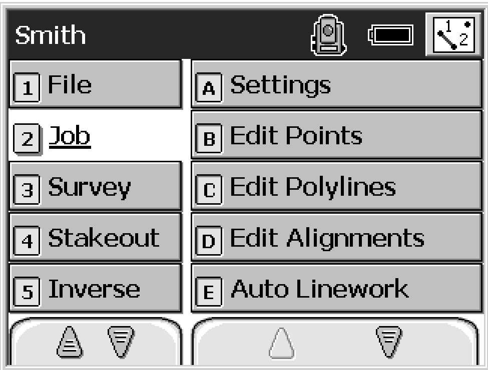
3. Another screen will open where you select some of the job settings. Select the settings that you desire and tap Next > to continue.



Note: When creating a new job, it is important that the Units for Distances field be set to the correct units. This allows you to seamlessly switch between different units in mid-job, but problems can arise if these units are inadvertently set to the incorrect units when new data is collected.

4. Since all jobs must have at least one point to start with, the final screen displays the default point name and coordinates for the first point. Accept the default values by tapping Finish. This will create and store the new job. You are now ready to explore the software.

Navigating Within the Program



The starting point in Survey Pro, which appears once a job is open, is called the Main Menu, shown here. All the screens that are available in Survey Pro are accessed starting from the Main Menu. Likewise, closing the screens in Survey Pro will eventually take you back to the Main Menu.

The Main Menu consists of two columns. The left column contains all of the available menus and the column on the right contains the menu items associated with the active menu.

When a menu is selected from the left column, the corresponding menu items will become available in the right hand column. When a menu item is activated from the right hand column, the corresponding screen will open. It is from these screens where you do your work.

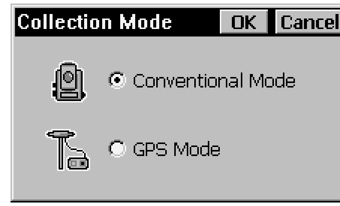
Navigation through the menus and menu items can be done using any of the methods described below. The best way to become familiar with navigating through the Main Menu is to simply try each method.

Each menu has a number associated with it, whereas the menu items have letters associated with them. Pressing the associated number or letter on the data collector's keypad will activate the corresponding menu or menu item.

You can scroll through the list of menus and menu items by using the arrow keys on the keypad. The up and down arrow keys will scroll up and down through the selected column. The other column can be selected by using the horizontal arrow keys.

You can also scroll through the list of menus and menu items by tapping the special arrow buttons  on the screen located at the bottom of each column. If one of these buttons appears blank, it indicates that you can scroll no further in that direction.

When the desired menu item is selected, it can be activated by tapping it or pressing the [**Enter**] key on the keypad.



There are three icons in the Main Menu's title bar. The first icon indicates which collection mode the software is running in. When surveying with a total station, the icon is displayed and when surveying with a GPS receiver, the icon is displayed. Tapping this icon will open the Collection Mode dialog box where the software can be switched to the other mode.

The battery icon indicates the condition of the data collector's rechargeable battery. The icon has five variations depending on the level of charge that is remaining: 100%, 75% 50%, 25% and LOW 5%.

The button in the title bar will access the map view of the current job when it is tapped. The map view is available from most screens and is discussed later.

Note: Tapping the battery icon is a shortcut to the Microsoft Power Properties screen, which is normally accessed from the Windows CE Control Panel. Tap the **?** button in the title bar of this screen to view the online help.

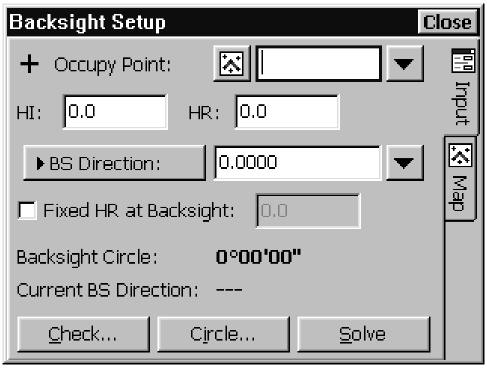
Hotkeys

There are several shortcuts available to quickly access a variety of screens no matter where you are at in the software. These shortcuts are called *hotkeys*. Each hotkey is activated by holding down the Ctrl key as you press the associated hotkey on the keypad. Each hotkey is listed below.

A	Calculator
B	Enter Note
D	View Points
E	View Raw Data
F	View Map
G	Inverse Point to Point
H	Corner Angle
I	Triangle Solutions
K	Manage Layers
L	Auto Linework
M	Horizontal Curve Solution
N	Vertical Curve Solution
S	Where is Next Point?
Y	Remote Control

Parts of a Screen

Many screens share common features. To illustrate some of these features, we will examine parts of the Backsight Setup screen, shown here. You can access the Backsight Setup screen by selecting [3 Survey], [A Backsight Setup] from the Main Menu.



Input Fields

An input field is an area where a specific value is entered by the user. An input field consists of a point label, which identifies the data that is to be entered in that field. It has a rectangular area with a white background, where the data is entered. A field must first be selected before data can be entered in it. You can select a field by tapping on it or pressing the [**Tab**] key on the data collector repeatedly until it is selected. When a field is selected, a dark border is drawn around it and a blinking cursor is inside the field. In the Backsight Setup screen above, the Occupy Point field is selected.

Output Fields

Output fields only display information. These fields typically display values in **bold text**, do not have a special colored background, and the value cannot be changed from the current screen. For example, in the Backsight Setup screen, the Backsight Circle value is an output field.

Power Buttons

The Backsight Setup screen contains two power buttons. Power buttons are typically used to provide alternate methods of entering or modifying data in an associated field. To use a power button, simply tap it. Once tapped, a dropdown list will appear with several choices. The choices available vary depending on with which field the power button is associated. Simply tap the desired choice from the dropdown list.

Tapping the first power button in the Backsight Setup screen allows you to specify an occupy point using other methods or view the details of the currently selected point. You should experiment with the options available with various power buttons to become familiar with them.

Choose From Map Button

The Choose From Map Button is always associated with a field where an existing point is required. When the button is tapped, a map view is displayed. To select a point for the required field, just tap it from the map.

Note: If you tap a point from the map view that is located next to other points, another screen will open that displays all of the points in the area that was tapped. Tap the desired point from the list to select it.

Scroll Buttons ▸ Button

When a button label is preceded with the ▸ symbol, it indicates that the button label can be changed by tapping it, thus changing the type of value that would be entered in the associated field. As you continue tapping a scroll button, the label will cycle through all the available choices.

In the Backsight Setup screen, the backsight can be defined by a point or a direction by toggling the scroll button between ▸ BS Point and ▸ BS Direction.

Special Point Symbols

Some field labels are preceded with a special symbol. For example, the Occupy Point field in the Backsight Setup screen is displayed as "+ Occupy Point" The plus symbol indicates that the occupy point is represented as a plus symbol when viewing it in the Map View. Other symbols are also used to represent other types of points.

Index Cards

Many screens have access to other screens that are still part of the original screen. The different screens are selected by tapping on various tabs, which look like the tabs of on index cards. Because of this, each individual screen is referred to as a *card*. The tabs can appear along the top of the screen or the right edge.

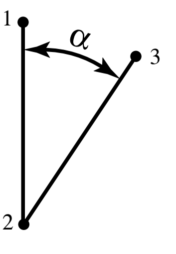
The Backsight Setup screen consists of two cards. One is titled Input, and the other is titled Map.

Input Shortcuts

Distances and angles are normally entered in the appropriate fields simply by typing the value from the keypad, but there is a shortcut that can simplify the entry of a distance or angle.

If you want to enter the distance between two points in a particular field, but you do not know offhand what that distance is, you can enter the two point names that define that distance separated by a hyphen. For example, entering 1-2 in a distance field would compute the horizontal distance from Point 1 to Point 2. As soon as the cursor is moved from that field, the horizontal distance between the points will be computed and entered in that field.

An alternate method to using this shortcut is to tap the ▼ power button, select Choose from map… and then tap the two points that define the distance that you want to enter. Once you tap OK from the Map View, the horizontal distance between the two tapped points will appear in the corresponding field.



Likewise, there is a similar shortcut to enter angles in fields that accept them. If you wanted to enter the angle, α, from the illustration shown here, you would simply enter 1-2-3 in the appropriate field. As soon as the cursor is moved from that field, the angle formed by the three points entered will be entered in that field. As with specifying a distance, you could also use the power button as described above and tap the points of the angle in the correct order.

Entering Distances in Other Units

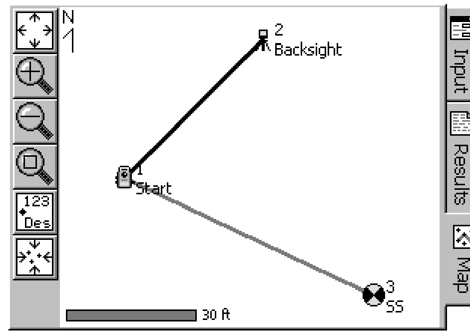
When a distance is entered in a particular field, it is normally entered using the same units that are configured for the current job, but distances can also be entered that are expressed in other distance units.

When entering a distance that is expressed in units that do not match those configured for the job, you simply append the entered distance with the abbreviation for the type of units entered. For example, if the distance units for your current job were set to feet and you wanted to enter a distance in meters, you would simply append the distance value with an m or M for meters. As soon as the cursor is moved to another field, the meters that you entered will be converted to feet.

The abbreviations can be entered in lower case or upper case characters. They can also be entered directly after the distance value, or separated with a space. The following abbreviations can be appended to an entered distance:

- Feet: **f** or **ft**
- US Survey Feet: **usf** or **usft**
- Inches: **in**
- Meters: **m**
- Centimeters: **cm**
- Millimeters: **mm**
- Chains: **c** or **ch**

The Map View



Many screens provide access to a map view. The map view is a graphical representation of the points and other useful information in the current job and can be accessed with the and buttons. A bar is shown at the bottom that indicates the scale of the map view.

The buttons along the left edge of the screen allow you to manipulate the map view so that it displays what you want to see.

Some map views also display a vertical profile.

Tip: You can pan around your map by dragging your finger or stylus across the screen.

Zoom Extents Button

This button will change the scale of the screen so that all the points in the current job will fit on the screen.

Zoom In Button

This button will zoom the current screen in by approximately 25%.

Zoom Out Button

This button will zoom the current screen out by approximately 25%.

Zoom Window Button

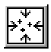
After tapping this button, a box can be dragged across the screen. When your finger or stylus leaves the screen, the map will zoom to the box that was drawn.

Increase Vertical Scale

This button is only available when viewing a vertical profile. Each time it is tapped, the vertical scale of the view is increased.

 Decrease Vertical Scale

This button is only available when viewing a vertical profile. Each time it is tapped, the vertical scale of the view is decreased.

 Zoom Preview Button

When this button is available, it will display only the points that are currently in use.

Display / Hide Labels Button

In some screens, this button will simply toggle the point names and descriptions on and off in a Map View, but in other screens it will open the Map Display Options screen, which gives you even more control over what is displayed in the Map View.

The Settings Screen

The Settings screen is used to control all of the settings available for your total station, data collector, current job, and Survey Pro software. It contains several index card-style tabs. Each card contains different types of settings.

Most of the settings remain unchanged unless you deliberately change them, meaning the default settings are whatever they were set to last. For example, if you create a new job where you change the direction units from azimuths to bearings and then create another new job, the default direction units for the new job will be bearings.

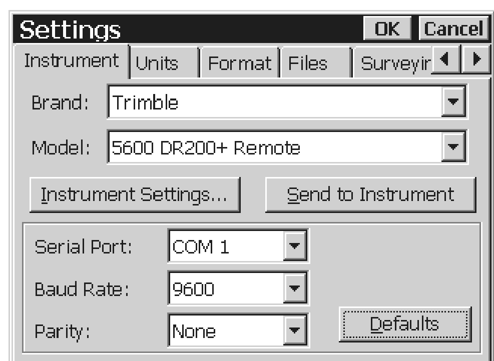
Survey Pro behaves in this way since most people use the same settings for a majority of their jobs. This way, once the settings are set, they become the default settings for all new jobs and current jobs.

Some settings are considered critical and are therefore stored within the job. The following settings are stored within a job and will override the corresponding settings in the Settings screen when it is opened:

- Scale Factor – Surveying Settings Card
- Earth Curvature On or Off – Surveying Settings Card
- Units for Survey Data (distances) – Units Settings Card
- North or South Azimuth – Units Settings Card
- Angle Units – Units Settings Card
- GPS setup information such as localization, mapping plane, etc. (Requires GPS Module)

Note: You can scroll to additional tabs when they are not in view by using the ◄► buttons.

Instrument Settings Page



The Instrument Settings are used to define the type of total station that is being used so it can communicate with the data collector. When your data collector is connected to a total station, the Brand and Model should be selected to match your total station. If your exact model is not listed, you should select from the models that are available until you find one that works.

When set to Manual Mode, the data collector will not communicate with a total station. Instead, when a button is pressed that would normally trigger the total station to take a shot; a dialog box will open where you enter the shot data manually from the keypad. When you are learning the software in an office environment, it is usually easiest to set the software to manual mode.

Model: is where you specify the model of the total station that you are using from a dropdown list. When a particular model is selected, the default settings for that model are automatically selected. If those setting are changed manually, you can switch back to the default settings by tapping the Defaults button.

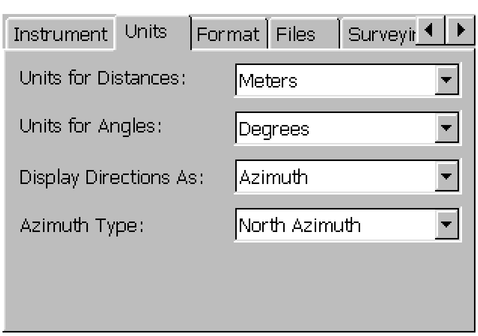
The Instrument Settings... button accesses the settings that are specific for the selected total station model. This screen can also quickly be accessed from anywhere in the program by using the.

Note: The options available after tapping the Instrument Settings... button, or the Ctrl-W hotkey directly toggle settings that are built into your particular total station. These settings are explained in your total station's documentation and are not explained in the Survey Pro Manual.

The Send to Instrument button is available when certain models are selected. When this button is available, it should be tapped after turning the total station on. This will send an initializing string to the instrument that will make certain robotic functions work more smoothly.

Units Settings

The Units Settings defines the units that are used within the software, including those that are sent from the total station, entered from the keypad and displayed on the screen. You can select the following settings for your job.



Units for Distances: defines the units used for distances as Meters, Feet, or International Feet.

Units for Angles: defines the units used for angles as Degrees or Grads.

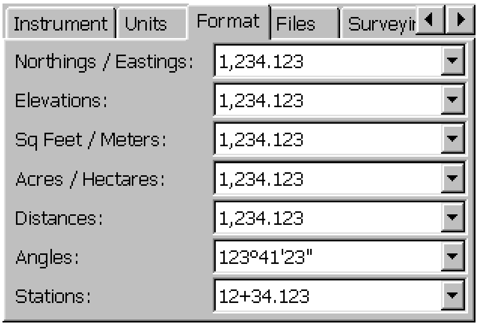
Display Directions As: will display directions as a Bearing or Azimuth.

Azimuth Type: defines if you are using a North Azimuth or a South Azimuth.

Format Settings

The Format Settings defines the precision (the number of places beyond the decimal point) that is displayed for various values in all screens, and how stations are defined.

Note: All internal calculations are performed using full precision.



Northings / Eastings: will allow you to display from zero to six places passed the decimal point for northing and easting values.

Elevations: allows you to display from zero to six places passed the decimal point for elevations.

Sq Feet / Meters: allows you to display from zero to four places passed the decimal point for square feet or square meter values.

Acres / Hectares: allows you to display from zero to four places passed the decimal point for acre or hectare values.

Distances: allows you to display from zero to six places passed the decimal point for distances.

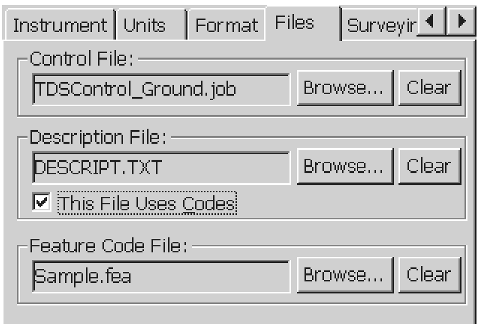
Angles: allows you to include from zero to four fractional seconds with angle values.

Stations: allows you to display stations in any of the following formats:

- 12+34.123: displays stations where the number to the left of the + advances after traveling 100 feet or meters.
- 1+234.123: displays stations where the number to the left of the + advances after traveling 1,000 feet or meters.
- 1,234.123: displays standard distances rather than stations.

Files Settings

The Files Settings allow you to select a control file or description file to use with the current job.



Control File: allows you to select a control file to use with the current job. Control files are discussed in more detail on Page 25.

Description File: allows you to select a description file to use with the current job. Description files are discussed in more detail on Page 29.

☑ **This File Uses Codes**: Check this box if the description file contains codes and associated descriptions. Leave the box unchecked if the description only contains descriptions (no codes).

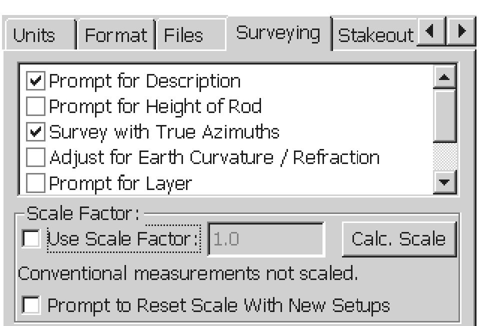
Feature Code File: allows you to select a feature code file to use with the current job.

[Browse]: allows you to select a file to use with the current job. Simply tap on the filename and then tap the [Open] button.

[Clear]: closes the currently selected file so that it is no longer used with the current job.

Surveying Settings

The Surveying Settings allows you to select various options that affect how data collection is performed.



☑ **Prompt for Description**: when checked, a prompt for a point description will appear before any new point is stored.

☑ **Prompt for Height of Rod**: when checked, a prompt for the rod height will appear before any new point is stored.

☑ **Survey with True Azimuths**: when checked, angle rights will be referenced from true north when traversing.

☑ **Adjust for Earth Curvature / Refraction**: when checked, the elevations for new points are adjusted to compensate for the curvature of the earth and refraction.

☑ **Prompt for Layer**: when checked, a prompt to select a layer will appear before any new point is stored from only the routines under the Survey menu.

☑ **Prompt for Attributes**: when checked, a prompt to select feature information will appear before any new point is stored from only the routines under the Survey menu. This also requires that a feature file be selected from the Files Settings card, described above.

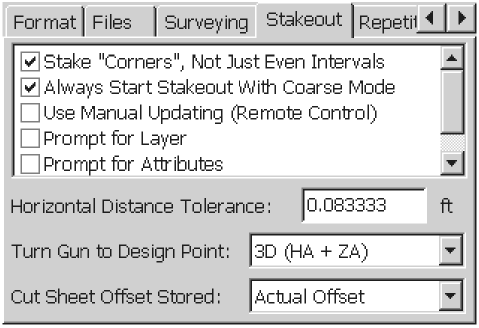
☑ **Use Scale Factor**: when checked, horizontal distances to all new points will be scaled by the factor entered here. Elevations are not affected.

Calc. Scale: allows you to automatically compute the scale factor from a selected map projection. If a mapping plane is not already selected, you will fist be prompted to select one.

☑ **Prompt to Reset Scale on New Setups**: if checked when a map projection is selected and you setup over a new location, the specified scale factor is compared to the scale factor defined for your current location in the mapping plane. If the scale factor is different, you will be prompted to use the new scale factor.

Stakeout Settings

The Stakeout Settings contains the setting that control how stakeout is performed.



Stake "Corners," Not Just Even Intervals: when staking by stations, locations where a line segment changes, such as from a straight section to a curve, will also be staked when this is checked.

Always Start Stakeout With Coarse Mode: when checked, the Coarse EDM (fast shot) checkbox found in all stakeout screens will initially be checked. This instructs the total station to measure distances faster, but with slightly less accuracy.

Use Manual Updating (Remote Control): When this is checked, an Update button in the stakeout screens must be pressed to take a shot. When this not checked, shots are continuously taken in the stakeout screens. (This is only valid when running in remote mode using a robotic total station.)

☑ **Prompt for Layer**: when checked, a prompt to select a layer will appear before any new point is stored from only the routines under the Stakeout menu.

☑ **Prompt for Attributes**: when checked, a prompt to select feature information will appear before any new point is stored from only the routines under the Stakeout menu. This also requires that a feature file be selected from the Files Settings card, described earlier.

Note: There is no Prompt for Description checkbox as in the Survey Settings because you will always be prompted for a description when storing a point from a stakeout routine.

Horizontal Distance Tolerance: this setting affects the Remote Staking and Stake to Line routines. When staking to a line and the prism is located at a perpendicular distance to the specified line that is within the range set here, a message will state that you are on the line. When performing Remote Stakeout, the final graphic screen that is displayed when you are near the stake point will occur when you are within the distance to the stake point specified here.

Turn Gun To Design Point: only applies to motorized total stations. The following options are available:

- Yes: 2D (HA only): The total station will automatically turn horizontally toward the design point.
- Yes: 3D (HA and ZA): The total station will automatically turn horizontally and vertically toward the design point.
- No: The total station must be turned manually.

Cut Sheet Data stored: when storing a stake point, the data that is stored depends on the following selection made here:

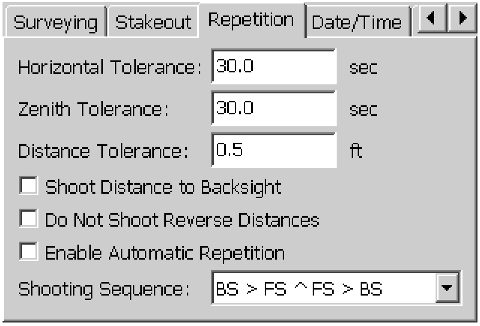
- Cut Sheet and Points: When a stake point is stored, cut / fill data is stored to the current raw data file *and* the point coordinates are stored in the current job.
- Cut Sheet only: When a stake point is stored, only cut / fill data for that point is stored to the current raw data file. (Point coordinates are *not* stored.)
- Points only: When a stake point is stored, only the point coordinates are stored in the current job. (Cut / fill data is *not* stored.)

Cut Sheet Offset stored: The cut sheet offset information can be stored to the raw data file in either of the following formats when performing any offset staking routine:

- Design Offset: when selected, a cut sheet report will list the design-offset values.
- Actual Offset: when selected, a cut sheet report will list the measured-offset values.

Repetition Settings

The Repetition Settings contains the settings that control how repetition shots are performed and the acceptable tolerances.



Horizontal Tolerance: a warning message will be displayed if a horizontal angle exceeds the tolerance entered here during a repetition shot.

Zenith Tolerance: a warning message will be displayed if a vertical angle exceeds the tolerance entered here during a repetition shot.

Distance Tolerance: a warning message will be displayed if a distance exceeds the tolerance entered here during a repetition shot.

Shoot Distance To Backsight: when checked, a distance will be measured to each shot to the backsight. When unchecked, only the angles are measured.

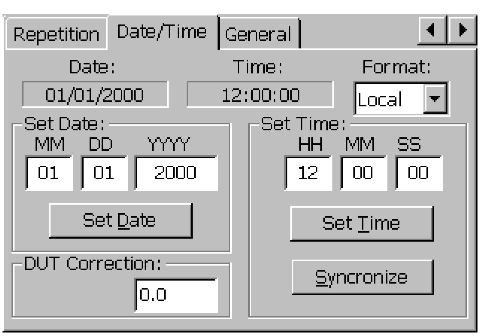
Do Not Shoot Reverse Distances: when checked, distances are not measured during reverse shots.

Enable Automatic Repetition: when checked, all remaining shots after the first shot to the backsight and foresight will occur automatically when using a motorized instrument.

Shooting Sequence: specifies the order that the shots are taken from the following options:

- BS > FS ^ FS > BS: Backsight, Foresight, *reverse* Foresight Backsight
- BS > FS ^> BS > FS: Backsight, Foresight, *reverse* Backsight, Foresight
- BS ^ BS > FS ^ FS: Backsight, *reverse* Backsight, Foresight, *reverse* Foresight
- FS ^ FS > BS ^ BS: Foresight, *reverse* Foresight, Backsight, *reverse* Backsight
- FS > BS ^ BS > FS: Foresight, Backsight, *reverse* Backsight, Foresight
- FS > BS ^> FS > BS: Foresight, Backsight, *reverse* Foresight, Backsight

Date/Time Settings



The Date/Time Settings is used to set the date and time in the data collector.

Date: displays the current date.

Time: displays the current time.

Format: Select Local to display your local time, or UTC to display Coordinated Universal Time.

Note: The date, time and UTC are computed using Windows CE's Date/Time properties.

Set Date: will set the system date with the date that is entered.

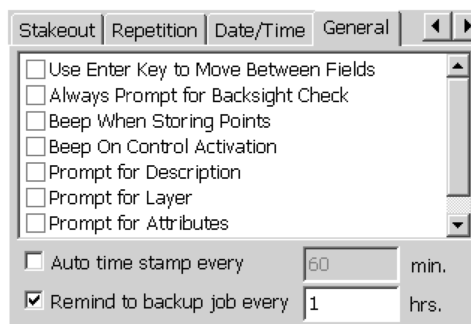
Set Time: will set the system time with the time entered.

Synchronize: when pressed, will zero the fractional portion of the current time and advance to the nearest second so that the time can be set more accurately.

Set DUT: is the polar wandering correction factor, in seconds, used to convert UTC to UT1. (UT1=UTC+DUT)

General Settings

The General Settings contains the following settings:



☑ **Use Enter Key to Move Between Fields**: when checked, the [**Enter**] key will move the cursor to the next field in all screens. When unchecked, the [**Enter**] key will perform a different function depending on the field selected.

Note: The arrow keys and the [**Tab**] key can also be used to move the cursor between fields.

☑ **Always Prompt for Backsight Check**: when checked, you will be prompted if you attempt to exit the Backsight Setup screen without first performing a backsight check.

☑ **Beep When Storing Points**: when checked, a beep will sound whenever a new point is stored.

☑ **Prompt for Description**: when checked, a prompt for a description will appear before any new point is stored from any routine other than those included in the Survey and Stakeout menus.

☑ **Prompt for Layer**: when checked, a prompt to select a layer will appear before any new point is stored from any routine other than those included in the Survey and Stakeout menus.

☑ **Prompt for Attributes**: when checked, a prompt to select feature information will appear before any new point is stored from any routine other than those included in the Survey and Stakeout menus. This also requires that a feature file be selected from the Files Settings card, described earlier.

☑ **Backup Reminder When Closing Job**: when checked, a reminder will open to backup the current job prior to closing it.

☑ **Auto time stamp every ___ min**: when checked, will store a note record to the raw data file containing the current date and time each time the specified number of minutes passes. This is useful for tracking down when specific raw data records were written to the file.

☑ **Remind to backup job every ___ hrs**: when checked, will open a reminder to backup the current job after every specified number of hours passes.

Required Files

Every job that is used with TDS Survey Pro actually consists of at least two separate files; a job file and a raw data file. Each file performs a different role within the software.

A job file can be created in the data collector, or on a PC using TDS Survey Link and then transferred to the data collector. A raw data file is automatically generated once the job file is open in the data collector. A raw data file cannot be created using any other method.

There are two other optional types of files that can be used with Survey Pro called control files and description files. Job files and raw data files are explained below. Control files and description files are explained, starting on Page 25 and 29, respectively and include examples to illustrate their use.

Job Files

A job file is a binary file that has a file name that is the same as the job name, followed by a *.JOB extension. A job file is similar to the older TDS-format coordinate file, except in addition to storing point names and their associated coordinates, a job file also contains all of the line work as well.

When you specify points to use for any reason within Survey Pro, the software will read the coordinates for the specified points from the job file. Whenever you store a new point within Survey Pro, the point is added to this file.

A job file can be edited on the data collector when using the Edit Points screen. Since a job file is binary, it requires special software for editing on a PC, such as TDS Survey Link. It can also be converted to or from an ASCII file using Survey Link. (Refer to the Survey Link documentation for this procedure.)

When a job file is converted to an ASCII file, the resulting file is simply a list of points and coordinates. Each line consists of a point name, northing or latitude, easting or longitude, elevation or elliptical height, and a note where each value is separated by a comma.

Raw Data Files

A raw data file is an ASCII text file that is automatically generated whenever a new job is created on the data collector. It has the same file name as the job file (the job name), followed by the *.RAW extension.

A raw data file is essentially a log of everything that occurred in the field. All activity that can create or modify a point is written to a raw data file. Survey Pro never "reads" from the raw data file – it only writes to the file. Since a raw data file stores all of the activity that takes place in the field, it can be used to regenerate the original job file if the job file was somehow lost. This process requires the TDS Survey Link software.

Since a raw data file is considered a legal document, it cannot be edited using any TDS software other than appending a note to it using the View Raw Data screen. Editing a raw data file would invalidate all of its contents and is not supported in any way by TDS.

When viewing a raw data file on a PC using a simple text editor or on Survey Pro using the View Raw Data screen, the file is shown unaltered, which can appear somewhat cryptic. Appendix B, in the Reference Manual, explains all of the raw data codes to assist in reading the file using this method. When viewing the file from within Survey Link, the codes are automatically translated on the screen to a format that is easier to understand.

Control Files

A *Control File* is simply an existing job that is optionally opened within the current job so that the points from the control file are also available for use in the current job. The points stored in a control file are called *Control Points*.

Some users prefer to keep a set of known points in a separate control file when repeatedly working on new jobs in the same general area. That way when they return to the job site, they can create a new job, but select the control file to easily have access to the known control points.

Once a control file is selected in the current job, the control points can be used in the same way as the job's points with the following exceptions:

- A control file has *read only* attributes. This means that the points in a control file cannot be modified or deleted; they can only be read. For example, you can select a control point to use as an occupy point during data collection or as a design point during stake out, but you could not use a control point for a foresight where you intend to overwrite the existing coordinates with new coordinates. You would also be unable to modify a control point from the Edit Points screen.
- Since the points in a control file are essentially merged with the points in the current job, you cannot open a control file if any of the point names used in it are also used in the current job. If you attempt to do so, a dialog will tell you that a duplicate point name was encountered and the control file will not be opened.

- Only points are used from a control file. If a control file contains other objects, such as polylines or alignments, they will be ignored.

Control File Example

The following general example explains one scenario where a control file is used. In this example, a new job is created with a point that has arbitrary coordinates. The control file is selected and used to replace the arbitrary coordinates with coordinates that are in the same coordinate system as those in the control file. The steps in this example can be modified to fit your specific situation.

Assume that you already have a job that contains several known points for an area where you intend to work. You want to create a new job and select the existing job as a control file to make the control points available in the new job. Also, assume that the control file contains points named 1 through 10.

1. Create a new job by selecting [1 File], [A Open/New] from the Main Menu.
2. Enter a point name for the first point in the job that will not conflict with the names that are in the control file. In this example, you could enter either any alphanumeric name or any numeric name that is above 10. (Accept the default coordinates for now – they will be overwritten later.)
3. Select the Files tab from the Settings screen.
4. Tap the [Browse] button in the Control File section of the screen and select the job that you want to use as a control file.
5. Define your Occupy and Backsight points using points from the control file and enter the point name that was just created as the Foresight.
6. Take a side shot or traverse shot and overwrite the original coordinates with the new coordinates. This will tie in the coordinates for the new point with the coordinates in the control file.
7. Continue your survey.

Description Files

A *Description File* is used to automate the task of entering descriptions for points that are stored in a job. They are especially useful when the same descriptions are frequently used in the same job.

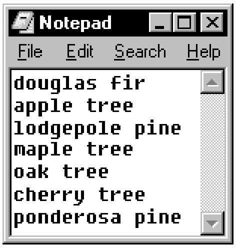
A description file is a text file containing a list of the descriptions that you will want to use with a particular job. The file itself is usually created on a PC, using any ASCII text editor such as Notepad, which is included with Microsoft Windows. It is then saved using any file name and the .txt extension and then transferred to the data collector.

It is important to realize that when you use a more sophisticated application, such as a word processor to create a description file, you must be careful how the file is saved. By default, a word processor will store additional non-ASCII data in a file making it incompatible as a description file. However this can be avoided if you use the File | Save As… routine from your word processor and choose a Text Only format as the type of document to save. For more information on creating a text file using a word processor, refer to the your word processor's documentation.

Description files can be created in two different formats; one includes codes and the other does not. The chosen format determines how descriptions are entered. Each format is described below.

Description Files Without Codes

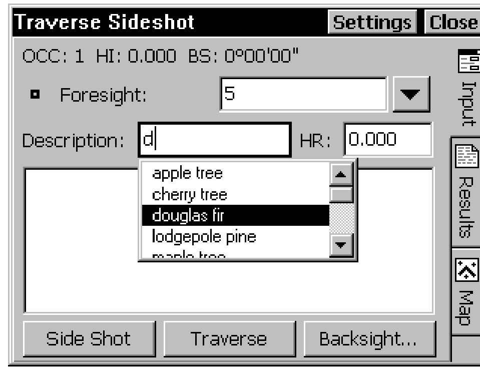
A description file that does not contain codes is simply a list of the descriptions that you will want to use in a job. The content of a sample description file, without codes, is shown here.



The following rules apply to description files without codes:

- Each line in the file contains a separate description.
- A description can be up to 16 characters in length (including spaces).
- A description can contain any characters included on a keyboard.

- Descriptions do not need to be arranged in alphabetical order. (Survey Pro does that for you.)
- Descriptions are case sensitive.



To use a description from a description file, simply start typing that description in any Description field. (You can experiment with descriptions in the [3 Survey], [B Traverse / Sideshot] screen.) Once you start typing a description, a dropdown list will appear displaying all of the descriptions in alphabetical order. If the first letter(s) that you typed match the first letters of a description in the description file, that description will automatically be selected in the dropdown list. Once it is selected, you can have that description replace what you have typed by pressing [**Enter**] on the keypad. You can also use the arrow keys to scroll through the dropdown list to make an alternate selection.

If you wanted douglas fir to be selected with the sample description file used here, you would have to start typing with lower case characters since descriptions are case sensitive. (Typing Dou… would **not** work.)

Description Files With Codes

A description file that uses codes is similar to those without codes, except a code precedes each description in the file. A sample description file with codes is shown here.

The following rules apply to description files that use codes:

- Each line in a description file begins with a code, followed by a single space, and then the description.
- A description code can consist of up to seven characters with no spaces.
- Description codes are case sensitive.
- The description is limited to 16 characters.
- Descriptions can include any character included on a keyboard.

To use a description from a description file with codes simply type the code associated with the desired description in any Description field. As soon as soon as the cursor moves out of the Description field, the code is replaced with the corresponding description. For example, if you typed lo in a description field while using the description file shown above, lo would be replaced with Lodgepole Pine once the cursor was moved to another field.

You can combine a description with any other text, or combine two descriptions by using an ampersand (&). For example, entering Tall&do would result in a description of Tall Douglas Fir. Entering b&oa would result in a description of Big Oak Tree. This method also works when spaces are included with the & character. For example, entering b&oa would have the same result as entering b & oa.

Note: Remember to check the This File Uses Codes checkbox when opening a description file that contains codes, described next.

Opening a Description File

Once a description file is created and stored in the data collector, it is activated with the following steps:

1. Select [2 Job], [A Settings] from the Main Menu.
2. Select the Files tab and tap the [Browse] button in the Description File section of the screen.
3. All of the files with a .txt extension will be displayed. Select the file that you want to use and tap [Open].
4. If the description file contains codes, check the This File Uses Codes checkbox.

Feature Codes

As explained above, a description or descriptor codes can be used to help describe a point prior to storing it, but this can be a limited solution for describing certain points.

Survey Pro also allows you to describe any object using *feature codes*. Feature codes can be used to describe objects quickly and in more detail than a standard text description, particularly when data is collected for several points that fit into the same category. For example, if the locations for all the utility poles in an area were being collected, a single feature code could be used to separately describe the condition of each utility pole.

When describing an object using feature codes, a selection is made from any number of main categories called *features*. Once a particular feature is selected, any number of descriptions can be made from sub-categories to the selected feature called *attributes*.

In general, a feature describes what an object is and attributes are used to describe the details of that object.

To take advantage of feature codes, a feature file must first be created using the TDS Survey Attribute Manager, which is included in version 7.2, or later of the TDS Survey Link software.

The TDS Survey Attribute Manager can also be used to view or modify the selected features in a particular job and to export them to any of several different file formats for use in other popular software packages.

Warning: Once a feature file is used in a job, that feature file cannot be modified and then reassigned to that job unless all of the existing attributes stored in the job are first removed.

For more information on creating a feature file, refer to the Survey Attribute Manager section of the Survey Link manual.

Features

The primary part of a feature code is called a *feature*. Features generally describe what an object is. Two types of features are used in Survey Pro: *points* and *lines*, which are described below.

When assigning a feature to data that was collected in Survey Pro, only features of the same type are available for selection. For example, if selecting a feature to describe a point in a job, only the point features are displayed. Likewise, if selecting a feature to describe a polyline, only the line features in the feature file are displayed.

- **Point Features**
  A point feature consists of a single independent point. Examples of a point feature would be objects such as a tree, a utility pedestal, or a fire hydrant.
- **Line Features**
  A line feature consists of two or more points that define a linear object, such as a fence or a waterline. In Survey Pro, these are stored as polylines, but line features can also be used to describe alignments.

Attributes

A feature, by itself, would not be useful in describing a point or line with much detail since a feature only helps describe what the stored point is. *Attributes* are used to help describe the details of the object.

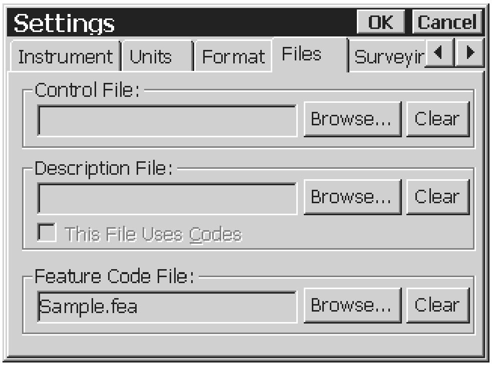
Attributes are either typed in from the keyboard or selected from a pull-down menu and fall into the following three categories.

- **String Attributes**
  A string attribute consists of a title and a field where the user can type any characters from the data collector's keypad up to a specified maximum length. An example of a string attribute is an attribute titled Notes where the user would type anything to describe a feature.
- **Value Attributes**
  A value attribute accepts only numbers from the keypad. These attributes are setup to accept numbers that fall in a specified range. Some examples of a numeric attribute would be the height of a tree or a utility pole's ID number.

- **Menu Attributes**
  A menu attribute is an attribute that is selected from a pull-down menu rather than typed in from the keypad. Menu items can also have sub-menu items. For example, you could have a feature labeled Utility with a pull-down menu labeled Type containing Pole and Pedestal. There could also be sub-menu items available that could be used to describe the pole or pedestal in more detail. Menus can only be two levels deep, but there is no limit to the number of items that can be listed in a pull-down menu.

Using Feature Codes in Survey Pro

Before you can use features and attributes to describe points in Survey Pro, you must select a valid feature file to use with the current job.



To select a feature file, open the [2 Job] [A Settings] screen and then select the Files card. Tap the bottom [Browse...] button, locate and select the appropriate *.FEA feature file.

Once a feature file is selected for the current job, you can configure Survey Pro to prompt for attributes whenever a point, line, or alignment is stored. There are three cards within the [2 Job] [A Settings] screen to configure this prompt.

There is a ☑ Prompt for Attributes checkbox in the Survey card, the Stakeout card and the General card. The first affects if you are prompted for attributes only when an object is stored from the routines within the Survey menu. Likewise, the second affects only objects stored from the routines in the Stakeout menu. The prompt in the General card affects if you are prompted for attributes when an object is stored from any other routines, such as the COGO routines.

The features and attributes for existing points, polylines, and alignments can also be edited using the Edit Points and Edit Polylines and Edit Alignments screens, respectively.

Layers

Survey Pro uses layers to help manage the data in a job. Any number of layers can exist in a job and any new objects can be assigned to any particular layer. For example, a common set of points can be stored on one layer and another set can be stored on a different layer.

The visibility of any layer can be toggled on and off, which gives full control over the data that is displayed in a map view. This is useful to reduce clutter in a job that contains several objects. The objects that are stored on a layer include points, polylines, and alignments.

TDS ForeSight can read a JOB file and output an AutoCAD DXF file containing all the original layer information. This conversion can also be performed using TDS Survey Link 7.2, or later via the Survey Attribute Manager, which is included as part of that program.

Layer 0

Layers can be added, deleted and renamed with the exception of Layer 0. Layer 0 is a special layer that must exist in every job. It cannot be deleted or renamed.

Layer 0 provides two main functions: compatibility with AutoCAD; and is used as a layer for the storage of objects that are not assigned to any other layer. Since all the objects in a job have to be assigned to a layer, Layer 0 is always there so a situation cannot occur where an object is stored, but does not exist on any layer.

Other Special Layers

Some layers are automatically created, but unlike Layer 0, these layers behave exactly the same as any user-created layer; they can be renamed or deleted. Whenever a control file (Page 27) is selected for a job, a Control layer is automatically created and the points in the control file are stored to that layer. (Any non-point objects in a control file are always ignored.)

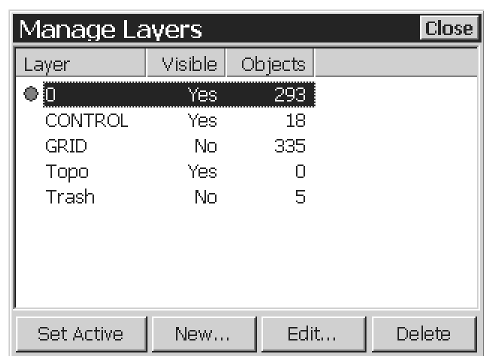
Similarly, whenever a new job is created, a Points layer is automatically created and selected as the active layer. The active layer is the default layer where any new objects will be stored.

Managing Layers

You can configure Survey Pro to prompt for a layer whenever an object is stored. If this prompt is turned off, any new objects that are stored will simply be stored to the active layer. There are three cards within the [2] Job [A] Settings screen to configure this prompt.

There is a ☑ Prompt for Layer checkbox in the Survey card, the Stakeout card and the General card. The first affects if you are prompted for a layer only when new data is stored from the routines within the Survey menu. Likewise, the second affects only data stored from the routines in the Stakeout menu. The prompt in the General card affects if you are prompted for a layer when data is stored from any other routines, such as the COGO routines.

Most layer management is performed from the [2] Job [H] Manage Layers screen. This screen allows you to add, delete, rename and change the visibility of the various layers. You can also set the active layer from here. This screen is also available from several different locations, such as the new Map Display Options screen and any of the controls that allow you to select layers. The Ctrl-[K] hotkey can also be used to access the Manage Layers screen.



Changing the Active Layer

To change the active layer, tap the desired layer and then tap the Set Active button. There must always be an active layer and there can only be one active layer at a time. The active layer is marked with the ● symbol.

Creating a New Layer

A new layer can be created by tapping New..., which opens the New Layer dialog box where a name and if the new layer should be visible is entered.

Changing a Layer Name or Visibility

Selecting a layer and then tapping Edit... opens the Edit Layer dialog box where the name and visibility can be changed for the selected layer. You can also edit a layer by double-tapping on it. (Layer 0 cannot be renamed.)

Deleting a Layer

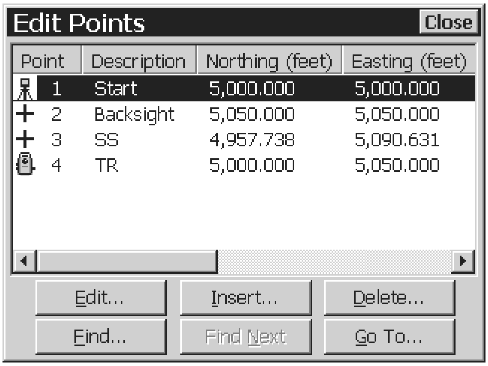
You can only delete an empty layer. If a layer contains any objects, they must first be moved to a different layer. To delete a layer, select the layer and tap Delete. (Layer 0 cannot be deleted.)

Moving Objects from One Layer to Another

The objects on a layer can be moved to a different layer using the object's appropriate edit screen. For example, to move several points from one layer to another, select the desired points in the Edit Points screen and tap Edit. Select the layer you want to move them to and tap OK.

2D / 3D Points

Survey Pro allows a job to contain 3D points as well as 2D points. Since a 2D point has no elevation associated with it, care should be taken when working with a job that contains any 2D points, especially if you still want to collect 3D points.



If you occupy a point that has no elevation, all the points that are collected from that setup will also have no elevations. Similarly, if you occupy a 2D point and perform stake out, no vertical data is provided.

You can quickly see if there are any 2D points in the current job by opening the [2 Job], [B Edit Points] screen. Any point where the elevation is shown as "---" is a 2D point.

Polylines

Lines can be added to your project that can represent anything such as a roadway, a building, or a lot boundary. These lines are referred to as *polylines*. Polylines can be compared to the point lists used in other TDS data collection software. They can consist of several individual curved and straight sections. A point must be stored in the project for all the locations on the polyline where a new section begins and ends.

Polylines can be used to compute information such as the perimeter and area for a lot boundary. They can also make it easier to compute and store offset points for the sides of a roadway when a polyline exists that defines a roadway centerline.

Refer to the Reference Manual for information on all the screens that are used to create and edit polylines.

Alignments

Alignments are similar to polylines in that they define specific lines in the current job and typically describe the centerline of a road. An alignment can then be used in the Offset Staking, Offset Points, Offset Lines, and Slope Staking screens. Unlike polylines, alignments do not need points for the locations where the alignment changes (called *nodes*).

Alignments are created by separately defining the horizontal and vertical details of a line. Although no points are required to define an alignment, the starting position must be tied to a specific location in the current job, the POB, which can be defined by an existing point or known coordinates.

The horizontal and vertical details of an alignment are defined in sections. The first horizontal and vertical section always begins at the specified starting location and each new segment is appended to the previous horizontal or vertical segment.

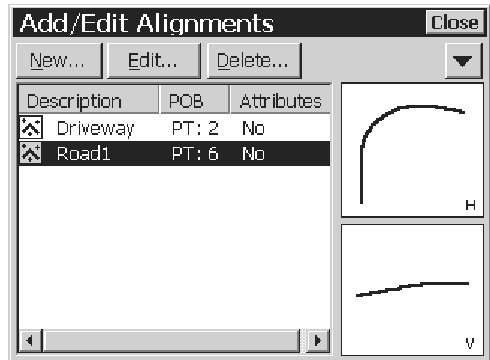
Once all the horizontal and vertical alignment segments are defined, Survey Pro merges the information to create a single 3-dimensional line.

The vertical alignment (VAL) must be equal in length or greater than the horizontal alignment. The HAL must not be greater than the VAL.

Creating an Alignment

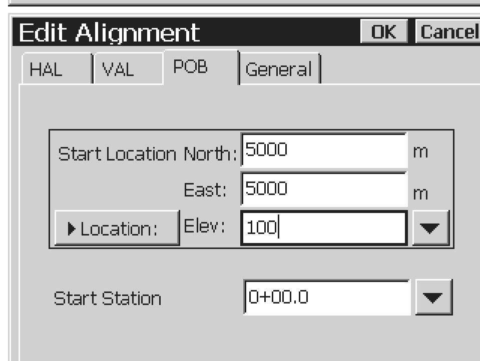
In this step-by-step example, we will create an alignment that has all the possible horizontal and vertical segment types.

1. Select [2 Job], [F Edit Alignments] from the Main Menu. If any alignments exist in the current job, they will be listed in this screen. An existing alignment can then be edited or deleted, but for this example, we will create a new alignment.



2. Tap [New...] to create a new alignment. This will open the Edit Alignments screen where you can begin adding horizontal and vertical segments.

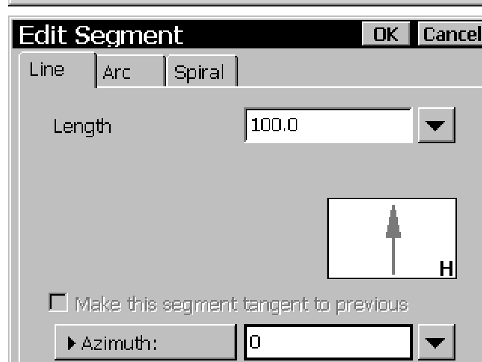
3. Tap the POB tab and enter North, East and Elev coordinates of 5000, 5000, 100. This will be the starting location of the horizontal and vertical definition. (Alternatively, you could define the starting location by tapping the [▸ Location] / [▸ Point] button where [▸ Point] is displayed and then select an existing point.)

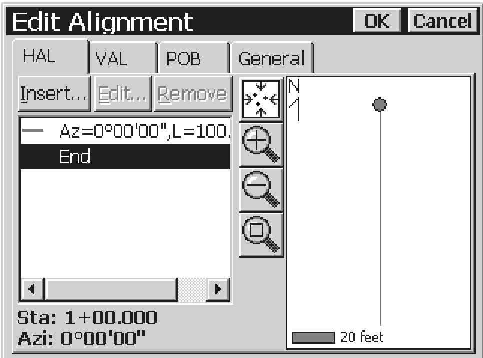


Horizontal Alignment

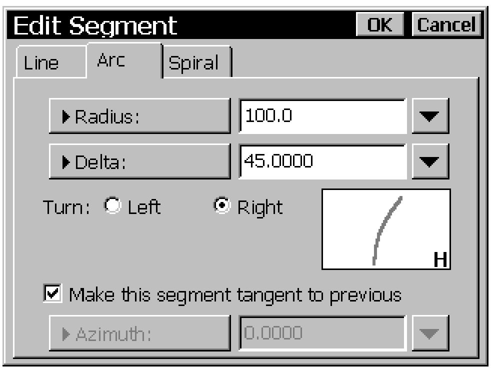
4. Tap the HAL (Horizontal Alignment) tab and then tap the [Insert] button. This will open the Edit Segment screen where the first horizontal alignment segment can be defined.

5. Tap the Line tab to insert a straight line segment. Enter a Length of 100 and an [▸ Azimuth] of 0.



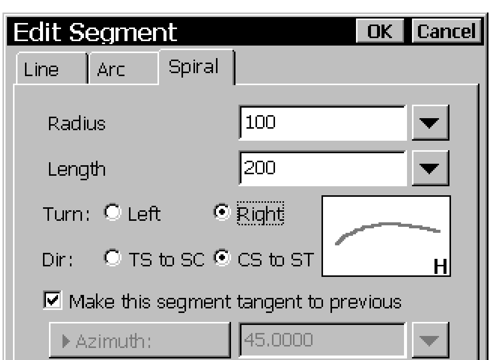


6. Tap OK at the top of the screen to add the segment to the horizontal alignment. You will return to the Edit Alignment screen where the new segment is displayed. The graphic shows every horizontal segment entered so far with the selected segment in bold. The dot in the picture indicates the beginning of the selected segment (in this case it is the end). This is where the next segment will be placed when using the Insert button.



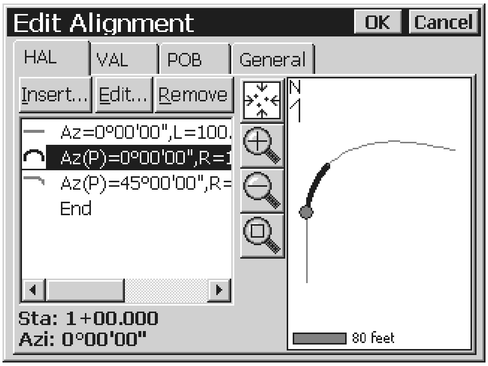
7. Tap the Insert button again and then tap the Arc tab to insert a horizontal curve.
8. Enter a Radius of 100, a Delta of 45 and select a Right turn. Check the Make this segment tangent to previous checkbox so that the curve will be positioned so the entrance to the curve is tangent to the end of the previous segment.
9. Tap OK to add the segment to the horizontal alignment.

Note: A new segment can be inserted between two existing segments by selecting the existing segment that is to occur after the new segment and then tapping the Insert button.



10. Tap the Insert button again and then tap the Spiral tab to insert a spiral curve.
11. Enter a Radius of 100, a Length of 200, select a Right of turn and a CS to ST direction, and check the Make this segment tangent to previous checkbox.
12. Tap OK to add the segment to the horizontal alignment.

Note: When creating a new horizontal segment and using the Make this segment tangent to previous option, the new segment will appear in the Edit Alignment screen tagged with a **(P)** (see picture). This means that if the previous horizontal segment is edited or deleted, thus changing the orientation, all subsequent horizontal segments that have the **(P)** tag will also be adjusted so they will remain tangent to the previous segments.



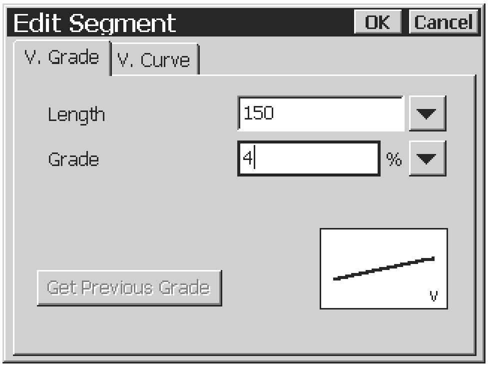
This does not hold true for vertical alignment segments. Vertical segments do not have the Make this segment tangent to previous option and will always begin with the specified starting grade unless they are manually modified.

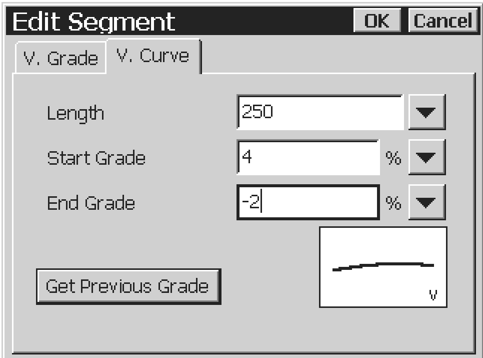
Vertical Alignment

We have now added all available horizontal segment types. Next, we will define the vertical alignment.

Since the horizontal and vertical alignments are defined independently of each other, the first vertical segment that is defined will start at the same POB defined above in Step 3.

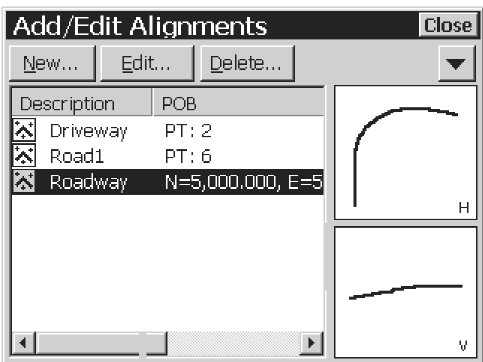
13. Tap the VAL (Vertical Alignment) tab and then tap the Insert button.
14. Tap the V. Line tab to insert a grade. Enter a Length of 150 and a Grade of 4%.
15. Tap OK to add the segment to the vertical alignment.





16. Tap the Insert button again and then tap the V. Curve tab to insert a parabolic vertical curve. Enter a Length of 250 and tap the Get Previous Grade button to automatically set the Start Grade to the ending grade of the previous section. Enter an End Grade of -2%.

17. Tap OK to add the segment to the vertical alignment.



18. Tap OK from the Edit Alignment screen. A prompt will ask for a description. Enter Roadway and Tap OK. You will return to the Add/Edit Alignments screen where the new alignment is stored and displayed.

You have now created a new alignment using all the available types of segments. You can select the new alignment for use in the Offset Staking, Offset Points and Offset Lines routines.

Note: If the horizontal and vertical alignments end at different stations, they can only be processed in the staking routines as far as the end of the shortest alignment.

Fieldwork

This section will explain how to get started using Survey Pro to collect data from a total station and perform stake out. It is assumed that you are familiar with the operation of your total station.

The first section describes the backsight setup procedures for various scenarios. The next section walks you through the steps involved to setup and perform a simple side shot and traverse shot. The third section walks you through a simple point-staking example.

The remainder of the chapter illustrates the procedures to perform the more complex routines in the Survey Pro software in a step-by-step manner. They are intended to explain only how to use a particular routine without the need for you to enter any specific values to read through the example.

When beginning any job, the setup is the same; you need to establish an occupy point and a backsight.

The occupy point is the point where you will setup the total station. The coordinates for the occupy point must exist in the current job or active control file. They can be assumed coordinates; known coordinates; or computed with the resection routine. (Control files and the resection routine are discussed later.) Any point in the current job can be an occupy point.

Once an occupy point is established, the second reference you need is a backsight point or direction. This can be in the form of a point stored in the current job, or an azimuth or bearing.

The horizontal angles recorded during data collection are relative to the backsight. If a point is not available in the job to use as a backsight, you can assume a backsight direction or you can use the solar observation routine, described later, to establish a backsight.

The scenarios below will describe four different possibilities for defining a backsight.

Scenario One

You know the coordinates and locations for two points on your lot and want to occupy one and use the other as a backsight.

Solution

1. Create a job using the coordinates for one of the known points as the first point.
2. Use the Edit Points routine to add a second point using the coordinates for the remaining known point.
3. From the Backsight Setup screen, set the Occupy Point field to the point number of one known point and setup the total station over that point.
4. Toggle the BS Direction / BS Point button to BS Point and enter the point name for the second known point in that field.
19. Aim the total station toward the other point, zero the horizontal angle on the instrument, and tap Solve, then Close. If the Always Prompt for Backsight Check option is checked in the Job | Settings | General screen, you will be prompted to check your backsight.

You are now ready to start your survey.

Scenario Two

You have found two points on your lot and know the azimuth between them, but you do not have coordinates for either.

Solution

1. Create a job using the default coordinates for the first point.
2. From the Backsight Setup screen, set the Occupy Point field to the point that was just created.
3. Setup the total station over the point where the known azimuth is referenced.

4. Toggle the BS Direction / BS Point button to BS Direction and enter the known azimuth to the second point here.
5. Aim the total station toward the second point, zero the horizontal angle on the instrument, and tap Solve, then Close.

You are now ready to start your survey.

You may want to take a side shot from the Traverse Sideshot screen to the backsight point so that you have coordinates for it. The horizontal angle would remain at zero during this shot.

If you later find true State Plane coordinates for any of the points in your job, you can use the Translate routine to adjust all the coordinates accordingly.

Scenario Three

You have one point established on your lot and you know the azimuth to an observable reference.

Solution

1. Create a job using the coordinates of the established point for the first point. If the coordinates are unknown, accept the default coordinates.
2. From the Backsight Setup screen, set the Occupy Point field to the point that was just created.
3. Setup the total station over the established point.
4. Toggle the BS Direction / BS Point button to BS Direction and enter the azimuth to the observable reference here.
5. Aim the total station toward the observable reference, zero the horizontal angle on the instrument, and tap Solve, then Close. If the Always Prompt for Backsight Check option is checked in the Job | Settings | General screen, you will be prompted to check your backsight.

If you later find true State Plane coordinates for any of the points in your job, you can use the Translate routine to adjust all the coordinates accordingly.

Scenario Four

You have only one known point on a job.

Solution

You have two options in this situation. One, you can assume an azimuth for an arbitrary backsight reference and rotate the job later using the Rotate routine once you have determined the actual orientation.

Secondly, you can use the Sun Shot routine to determine an azimuth to an arbitrary reference.

Summary

In general, you would follow these steps when you begin working on a job.

1. Create a new job or open an existing job.
2. Setup over the Occupy Point.
3. Aim the total station toward the backsight and zero the horizontal angle on the instrument.
4. Fill in the Backsight Setup screen and tap Solve, then Close. If the Always Prompt for Backsight Check option is checked in the Job | Settings | General screen, you will be prompted to check your backsight.
5. Start your survey.

Note: You should enter the correct Height of Instrument and Height of Backsight distances in the Backsight Setup screen if you plan to check your backsight using the Check by Distance routine.

Note: If the Backsight Circle displays a non-zero value, the angle displayed is subtracted from all horizontal angles that are read during data collection and the resulting points are adjusted accordingly. This will happen after survey with true azimuths or performing stakeout in a special mode. If you do not want this to happen, you should change this value to zero from the Backsight Circle dialog box by tapping the Backsight Circle button.

Most non-staking related data collection is performed from the Traverse / Sideshot screen. When you take a shot using the Traverse button, the routine expects that you will eventually be occupying the foresight that you are shooting and backsighting your current occupy point. When you are ready to setup on the next point, the occupy, foresight and backsight points will automatically be updated accordingly.

After taking a shot using the Side Shot button, the routine does not expect the total station to be moved before the next shot and will therefore only automatically advance the foresight point.

Data Collection Example

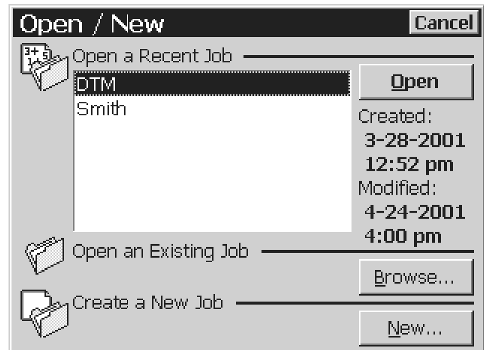
This section illustrates the necessary setup and usage of the Traverse / Side Shot screen, which is the primary screen used during data collection. We will create a new job and manually add another point to the job to use as a backsight. We will run in manual mode so the shot data must be entered manually. This example, and the following stakeout example are the only examples that are designed where the user should follow along and enter the values in their data collector as they are provided in the example.

Setup

1. Create a new job.

   a. From the Main Menu, select [1 File], [A Open / New].

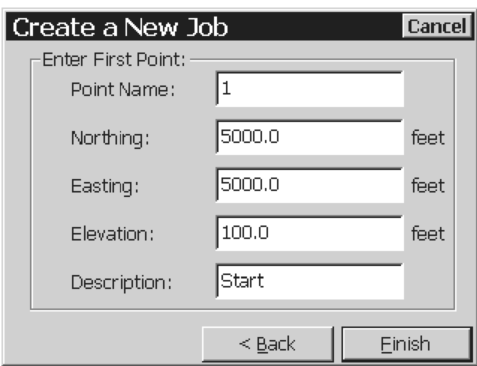
   b. Tap [New...] to open the Create a New Job screen



   c. Enter any job name that you wish in the Job Name field and tap [Next >].

   d. For this example, simply accept the default job settings and tap [Next >].

> **Note**: When creating a new job, it is important that the Units for Distances field be set to the correct units. This allows you to seamlessly switch between different units in mid-job.
>
> Problems can arise if these units are inadvertently set to the incorrect units prior to entering new data. For example, assume you created a control file by hand-entering a list of coordinates in a new job where the job was set to Feet and the coordinates were in US Survey Feet. Now assume you created another new job and correctly set it to US Survey Feet. If you then selected the previous job as a control file for the new job, the display of all of the coordinates in the control file would be converted from Feet to US Survey Feet.



e. Accept the default coordinates for the first job point by tapping Finish.

2. Check the Job Settings.

   a. Tap 2 Job, A Settings from the Main Menu to open the Settings screen.

   b. Tap the Instrument tab and make sure both the Brand and Model fields are set to Manual Mode.

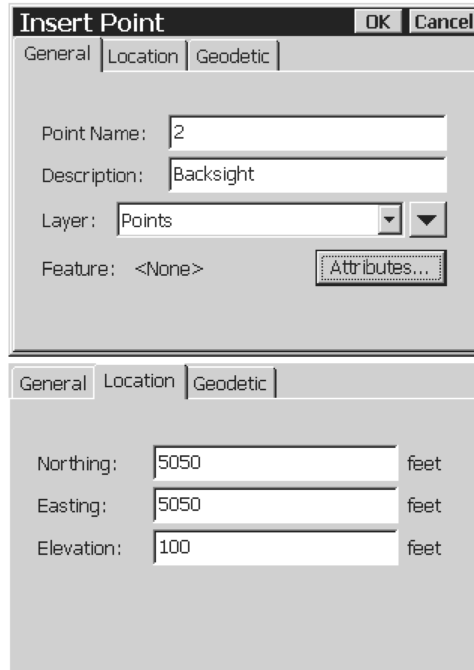
   c. For this example, tap the Survey card and un-check all the checkboxes.

   d. Tap OK to save the job settings.

3. Add a backsight point to the job.

   a. Select 2 Job, B Edit Points from the Main Menu.

b. Tap Insert... and enter a new point using the General and Location cards with the following values, as shown: Point Name: 2; Northing: 5050; Easting: 5050; Elevation: 100; Description: Backsight and then tap OK.



4. Set up your backsight. In this example, we will setup on Point 1 and backsight Point 2, which was just created.

   a. Access the 3 Survey, A Backsight Setup screen.

   b. In the Occupy Point field, enter 1 as the point name.

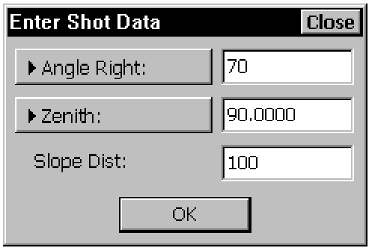
> **Tip**: You can also select an existing point from a map view or from a list by using the power button.

   c. Enter an HI and HR of 5 feet each.

   d. Toggle the BS Direction / BS Point button to BS Point and enter 2 as the point name.

   e. Leave the Fixed HR at Backsight field unchecked.

   f. Confirm that the Backsight Circle value is zero. If it displays a non-zero value, tap the Circle... button and set it to zero.

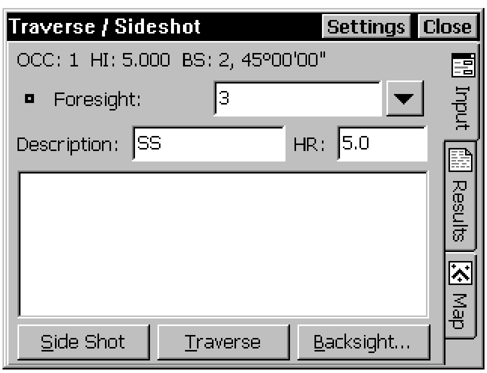


g. Tap Solve. The Map screen will open automatically.

h. Tap Close to continue.

Performing a Side Shot

5. Access the 3 Survey, B Traverse / Sideshot screen and fill in the appropriate fields. The backsight information is displayed at the top of the screen. At this point, it is assumed that your total station is over the occupy point and its horizontal angle was zeroed while aiming toward the backsight.

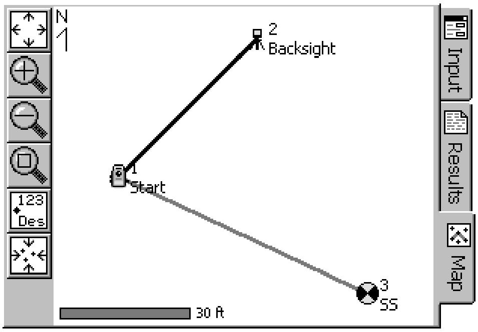


a. In the Traverse / Sideshot screen, enter the following data:
Foresight: 3
Description: SS
HR: 5
These values will define the point name, description, and rod height for the next point that is stored.

b. Assuming that the total station is aiming toward the prism, which is located over the foresight, tap Side Shot. This would trigger the total station to take a shot, compute coordinates for the new point and store it. Since we are running in manual mode, we will enter the shot data from the keypad.

c. Enter the following data:
Angle Right: 70
Zenith: 90
Slope Dist: 100 and then tap OK. The new point is computed and stored. The Foresight point will automatically advance to the next available point name and the information from the last shot is displayed on the screen.

d. You can see a graphical representation of the previous shot, as shown here, by tapping the Map tab. See Page 14 for more information on the Map View.



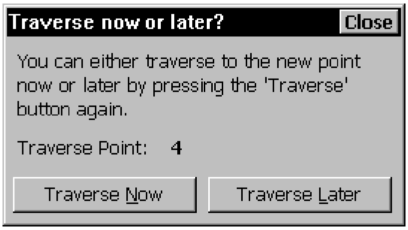
Performing a Traverse Shot

6. The steps involved in performing a traverse shot are nearly identical to performing a side shot. The difference is you must specify if you plan to move the total station to the current foresight point after the shot is taken.

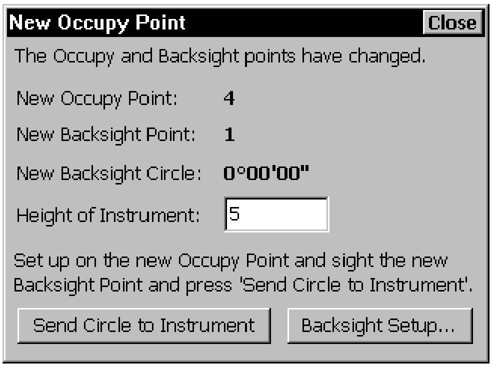
   a. Tap the Input tab of the Traverse / Sideshot. The Foresight point should now be updated to 4.

   b. Assuming that you are now aiming the total station at a prism located over the foresight point, tap Traverse. This would trigger the total station to take a shot, compute coordinates for the new point and store it. Since we are running in manual mode, we will enter the shot data from the keypad.

   c. Enter the following data:
      Angle Right: 45
      Zenith: 90
      Slope Dist: 50 and then tap OK.



The new point is computed and stored and the Traverse Now or Later prompt will open, shown here, asking if you want to advance to the new point now or later. For this example, tap the Traverse Now button. The New Occupy Point dialog box will open, shown here, which displays details of the new setup. You can see that the previous foresight point in now the current occupy point and the previous occupy point is now the current backsight point.



Note: If you select to traverse later, the traverse point is still stored, but you will then have the opportunity to shoot additional side shots before you advance to the next point. This is useful when you want to shoot the traverse shot first, before any settling occurs to the tripod. In that situation, when you are ready to advance, you would tap Traverse again where you would then answer to a prompt that asks if you are ready to advance or re-shoot the traverse point. (If you select to re-shoot the traverse point, the previous traverse point is stored as a side shot.)

d. Since we are running in manual mode and cannot send data to an instrument, tap Close. You will notice at the top of the Traverse Sideshot screen that the occupy point has been updated to 4, the backsight is updated to 1, and the foresight is updated to 5, which is the next available point name.

When out in the field, you would now move your total station over the new occupy point, aim it toward the previous occupy point (the current backsight), enter the correct instrument height in the Height of Instrument field and tap Send Circle to Instrument. This would update the Traverse / Side Shot screen and set the total station's horizontal angle to zero where you are then ready to collect more data.

You have now created a job, checked the settings, setup a backsight and collected data in the form of a side shot and a traverse shot. If, at any time, you want to view the coordinates of your points, you can do so from the [2] Job, [B] Edit Points screen.

Data Collection Summary

1. Open or create a job.
2. Check the job settings.
3. Setup a backsight.
4. Collect data in the form of traverse shots or side shots.

Stakeout Example

When setting up to perform stakeout, the requirements are nearly the same as with data collection. You need an existing occupy point, backsight point or direction, and a foresight. The main difference is existing points are being located during stakeout rather than new points being collected.

In the example below, all of the steps required to perform a simple point-staking job are explained from the initial setup to the staking itself. For consistency, this example assumes you are running Survey Pro in manual mode so the shot data will need to be input from the keypad. Since the software behaves differently in manual mode compared to when using a total station, the differences are noted where applicable.

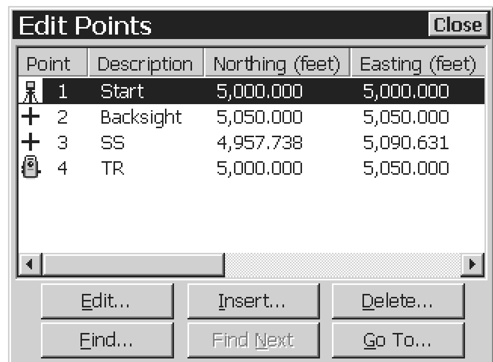
For this example we will use the job that was created with the Traverse / Side Shot Example, above. When staking the first point, we will take two shots to the prism to “home-in” on the design point. When staking the second point, we will only take one shot combined with the Store/Tape routine to store the stake point.

Set Up

1. Open the job that was created in the Traverse / Side Shot Example.

   a. From the Main Menu, select 1 File, A Open / New to open the Open / New screen.

   b. Tap the file name that was created earlier listed in the Open Recent Job list and then tap Open. The coordinates for that job are shown here.



2. Set the job settings. (Only the settings that affect this example are covered here.)

   a. Select 2 Job, A Settings from the Main Menu.

   b. Tap the Instrument tab and set both the Brand and Model fields to Manual Mode.

   c. Tap the Surveying tab and confirm that all of the checkboxes are unchecked.

   d. Tap the Stakeout tab and make sure the final field (Cut Sheet Offset Stored) is set to Actual Offset.

Note: When performing stakeout, you have the option of storing cut sheet information. This information is stored in the raw data file, and when using software on a PC, such as Survey Link, it can be extracted in the form of a Cut Sheet Report.

   e. Tap OK to save the job settings.

3. Setup your backsight. In this example, we will setup on Point 1 and backsight an object where it is assumed that the direction to that object is known. When connected to a total station, you would setup over your occupy point, aim toward the backsight and zero the horizontal angle in the total station before continuing.

   a. Access the 3 Survey, A Backsight Setup screen.

b. In the Occupy Point field, enter 1 as the point name.

c. Toggle the BS Direction / BS Point button to BS Direction and enter 0 as the backsight azimuth.

d. Enter an HI of 5 feet.

e. Leave the Fixed HR at Backsight field unchecked.

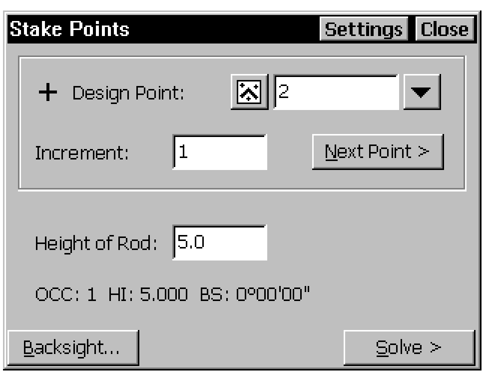
f. Confirm that the Backsight Circle value is zero. If it displays a non-zero value, tap the Backsight Circle button and set it to zero.

g. Tap Solve. A map view will open that shows a graphical representation of the occupy point and backsight direction. Tap Close to continue.

Staking Points

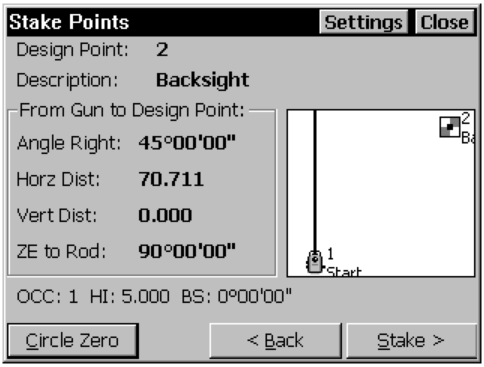
4. Stake the first design point (Point 2).

a. Access the 4 Stakeout, A Stake Points screen. The backsight information is displayed near the bottom of the screen. At this point, it is assumed that your total station is over the occupy point and its horizontal angle was zeroed while aiming toward the backsight.

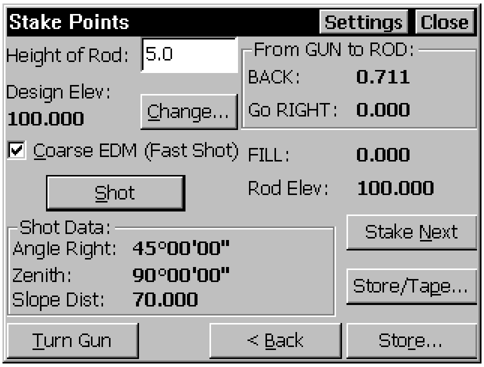


b. Enter the following data in the Stake Points screen:
Design point: 2
Increment: 1
Height of rod: 5 and tap Solve >.

c. The second Stake Points screen will open that displays all of the information needed to locate the design point. When connected to a total station, you would turn the total station horizontally to 45°00'00", vertically to 90°00'00" and send the rod man out about 70 feet before continuing. Tap the Stake > button to continue to the third screen.



d. With a Height of rod of 5, tap the Shot button. (See the Reference Manual for an explanation of the other fields.)



e. Enter the following shot data:
Angle Right: 45
Zenith: 90
Slope Dist: 70 and then tap OK to continue.

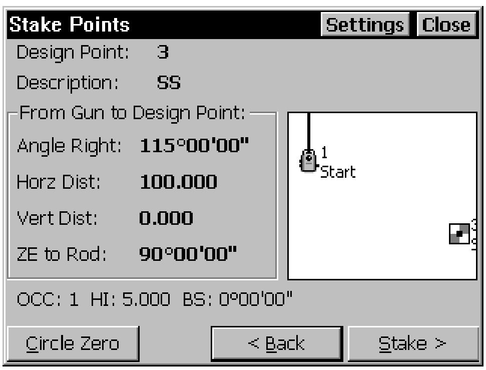
f. The Stake Points screen will show the necessary COME / GO and Go RIGHT / Go LEFT information that the rod man must move in order to be located over the design point. In this example, the Go RIGHT value indicates 0, which means the rod is precisely on the line between the total station and the design point. The BACK value indicates 0.711, which indicates that the rod must move back (away from the total station) 0.711 feet to be over the design point. The Fill value is zero so no dirt needs to be cut or filled at the rod location to match the design elevation.

g. Assuming the rod has been repositioned, take another shot by tapping the Shot button and enter the following new shot data:
Angle Right: 45
Zenith Angle: 90
Slope Dist: 70.8 and then tap OK to continue.

h. The rod must now move FORWARD by 0.089 feet to be over the design point. We will assume that this is close enough and will store the point from this shot by tapping the Store... button.

i. Enter the following point information:
Point Name: 5
Description: Staked and tap Store. This will return you to the first Point Stake screen.

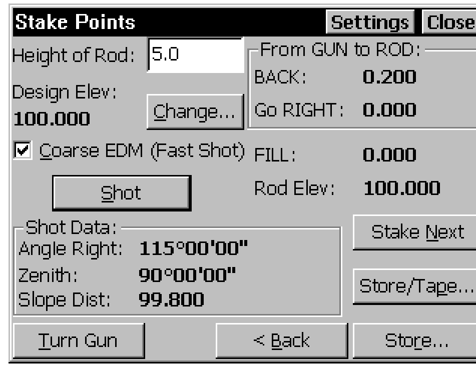
5. Stake the next design point.



a. We want to stake the next design point in the project. We can do this by entering 3 in the Design Point field and then pressing Solve >, or we can simply tap Next Point >, which will automatically advance the current design point by the increment value and solve automatically. Either method will send you to the second Stake Points screen.

b. The information needed to locate the next design point is displayed. When connected to a total station, you would turn the total station horizontally to 115°00’00”, vertically to 90°00’00” and send the rod man out about 100 feet before continuing. Tap the Stake > button to continue to the third screen.

c. Tap the Shot button and enter the following shot data:
Angle Right: 115
Zenith: 90
Slope Dist: 99.8 and then tap OK to continue.



d. The rod man needs to move back by 0.2 feet to be over the design point. Rather than take another shot, we will instruct him to use a tape and place a stake at that location. Tap the Store/Tape... button to store the point.

e. Enter the following data in the Store Point (Tape Offset) Dialog Box:
Point Name: 6
Description: Staked
Tape Out/Tape In (+/-): 0.2 and tap Store.
This will result in coordinates for the stored point that are 0.2 feet further from the total station than the last shot to the prism.

Note: Negative Tape Out/Tape In values are toward the total station and positive values are away from the total station.

Point Staking Summary

1. Open a job that contains the design points that you want to stake.
2. Check the job settings.
3. Setup a backsight.
4. Stake the points from the Stake Points screen.

Surveying with True Azimuths

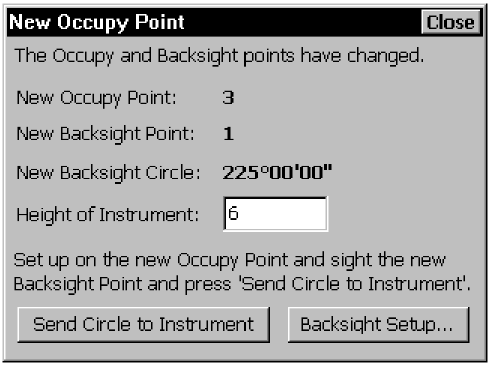
Some people need to collect all of their horizontal angles in the form of azimuths. Survey Pro CE can help automate this process by computing the backsight azimuth after each new setup in a traverse and updating the backsight circle and total station's horizontal angle accordingly.

1. You can setup on any existing point and use any other point in the job as a backsight if the coordinate system is properly aligned with true north. If not, you can occupy any point as long you have a known azimuth to any reference.
2. In the Surveying Settings screen (Job | Surveying | Settings), confirm that the Survey with True Azimuths checkbox is checked.
3. Setup the total station over the occupy point and aim it toward your backsight.
4. Access the Backsight Setup screen; enter the Occupy Point, and toggle the BS Direction / BS Point button to BS Direction.

Note: When backsighting on a point, selecting BS Direction can still be used, as described next, making it easier to view the azimuth to the backsight.

5. If backsighting a known azimuth, enter it in the BS Direction field. If backsighting a point, use the shortcut method to enter the azimuth from the occupy point to the backsight point in the BS Direction field. For example, if you are occupying Point 1 and backsighting Point 2, enter 1-2 in the BS Direction field. Once the cursor leaves that field, the computed azimuth will replace what you typed.
6. Tap the Circle... button, enter the backsight azimuth in the Backsight Circle field and tap Send to Instrument (or Set when running in Manual Mode). This will set the backsight circle as the horizontal angle in the total station and set the same angle as the Backsight Circle value. This angle will then be subtracted from all horizontal angles sent from the total station.

7. Begin your survey. When you traverse to a new point, the New Occupy Point dialog box will open showing you the azimuth computed to the new backsight point from the new occupy point. Once you are setup over the new occupy point, and aiming toward the new backsight point, press the Send Circle to Instrument button to update the Backsight Circle value and the horizontal angle on the total station. Repeat this step after setting up on each new traverse point.



Road Layout

Overview

The Road menu contains a powerful set of routines that allow you to enter and modify road layout information and then stake the road in the field. The road staking routines allow you to stake any part of the road or slope stake the road.

There are four basic components of a road: The Horizontal Alignment; the Vertical Alignment; Templates, and a POB. All of these components are described separately below and each is a required component to a complete road definition.

Horizontal Alignment (HAL)

The horizontal alignment, referred to as the HAL, defines the horizontal features of an alignment. It can contain information on straight, curved, and spiral sections of the alignment. Generally the HAL coincides with the centerline of a road, but it is not required to be the centerline. All stationing for an alignment will come from the HAL.

Vertical Alignment (VAL)

The vertical alignment, referred to as the VAL, defines the vertical components of the alignment including grades and parabolic vertical curves.

The VAL is generated in the same way as the HAL. The VAL can be the same length as the HAL, or longer, but it cannot be shorter.

Templates

Templates contain the cross section information for the road. Templates are stored in separate files with a TP5 extension so they can be used with multiple jobs. The templates are broken down into sections, called segments. Each segment contains a specified length, and slope or change in elevation. Templates can contain as many segments as needed, but must have at least one segment. Each segment describes one component of the cross section such as the roadbed, curb face, top of curb, ditch, etc. Each road alignment can contain as many templates as required to define the roadway, but all the templates used on one side of the road must have the same number of segments.

Templates can be further modified using widenings and super elevations:

Widenings are used to widen or to narrow the first segment of a template. The remaining segments of the template are not affected. This feature is intended to be a way of controlling the width of the first segment, typically the roadbed, without having to create and manage additional template files. Widening definitions basically act as two templates that modify the first segment.

Super elevations are used to bank curves in the direction of a turn. A super elevation accomplishes this by changing the slope of the first segment of a template – the slope of any remaining segments will remain unadjusted.

One super elevation defines a begin station and an end station where the slope change begins and where it finishes the transition for one side of a road. Therefore, to bank a two-lane road, four super elevations would be required – one at the beginning and one at the end of the curve for each side of the road.

A super elevation can either hinge at the outer edge of the first segment, or at the centerline. Hinging at the center results in the elevation of the outer segments to change. Hinging at the edge results in the elevation of the centerline changing. Because of this, Survey Pro will only allow you to hinge on edge for one side of a road. If the other side is also super elevated, you will be forced to hinge that side at the center so that an abrupt change in elevation does not occur at the centerline.

POB

The POB designates the location in the current job where the alignment starts. The POB can be defined by an existing point or specified coordinates and can be changed at any time. The VAL's start station elevation will be set from the POP.

Road Component Rules

The following section defines how the various components described above work together to form the road. This information is important because how each component reacts to the other component affects the shape of the resulting road.

Alignments

1. The alignment must have both HAL and VAL segments.
2. The VAL must be equal to, or longer than the HAL.

Templates

1. For each side of the road
    - All templates on a particular side of the road must have the same number of segments for. The fist template for each side of the road defines this number.
    - The station for the first template for each side must match the starting station of alignment.
    - All template stations must be within the station range for the alignment.
    - All templates must have at least one segment.
    - A template can contain one zero length segment making it effectively a blank template, but the first segment must be greater than 0.
    - Template segments must have a name. The template editor provides fields to enter the segment name.

2. Any two templates without intervening Widening or Super Elevations will transition.
    - This means that each template segment will transition at a linear rate from its existing offset from the centerline to the new offset from the centerline as defined by the new template.
3. A template’s first segment slope and/or width will be modified when:
    - A template is located within a Super Elevation or Widening definition including starting and ending stations and inside Widening or Super Elevation transition areas.
    - Templates will acquire first segment slope value from the Super Elevation definition, and/or acquire its first segment width value from the Widening definition.
4. Only one template may occupy any station.
    - As little as 0.001 units can be used to separate templates.

Widenings and Super Elevations.

1. Super Elevation and Widening stations must be within the station range of the alignment.
2. Super Elevations and Widenings follow the same rules except that the start and end stations of a Super Elevation are defined by:
    - Super Elevations will start their transitions at a point equal to the user defined starting station minus ½ of the starting parabolic transition length if parabolic transitions are used.
    - Super Elevations will start their transitions at a point equal the user defined ending station plus ½ of the ending parabolic transition length if parabolic transitions are used.
3. Super Elevation start slope value and Widening start width value must match the first segment value defined by:
    - A previous Super Elevation or Widening. (Priority)
    - A previous Template.

4. Super Elevation ending slope value and Widening ending width value must match the first segment value defined by:
    - A following Super Elevation or Widening. (Priority)
    - A following Template.
    - Exception: if the Widening or Super Elevation is the last element in the road, it's end transition value does not have to match anything.
5. Super Elevation and Widening ending stations must be greater than their beginning stations.
6. Widenings cannot adjust the first segment horizontal distance to or from 0.
7. Super Elevations and a Widenings may overlap, are independent, and do not affect each other.
8. Super Elevations may not overlap other Super Elevations.
    - A Super Elevation's ending station may be equal to a following Super Elevation's beginning station.
    - A Super Elevation's beginning station may be equal to a previous Super Elevation's ending station.
9. Widenings may not overlap Widenings.
    - A Widenings ending station may be equal to a following Widening's beginning station.
    - A Widening's beginning station may be equal to a previous Widening's ending station.
10. Super Elevations may hinge on edge.
    - Hinge on edge can only be used for one side of the road for any given Super Elevation station range.
    - If hinge on edge is used for one side of the road, Super Elevations must hinge from center on the opposite side of the road over the same station range.
    - Hinge on edge will modify the elevation of the Center Line.

Road Rules Examples

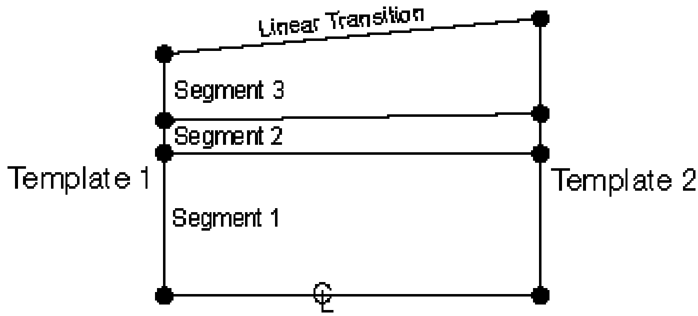


Figure 1 Overhead view of a template-to-template linear transition

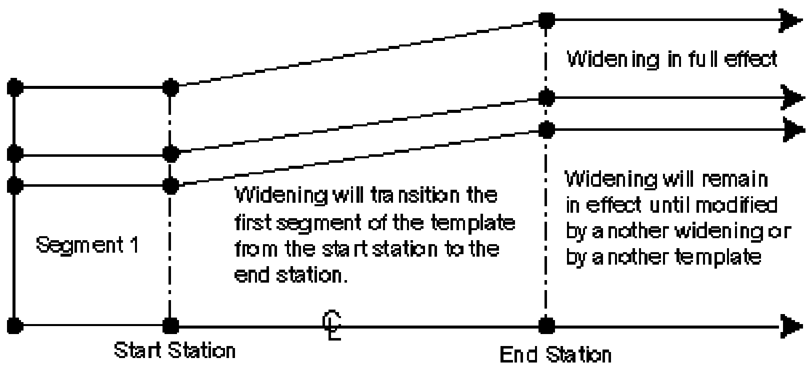


Figure 2 Template to Widening Transition

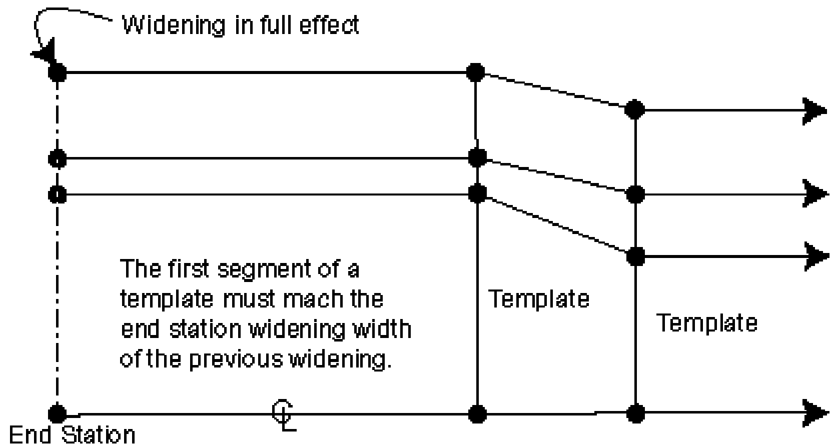


Figure 3 Widening to Template Transition

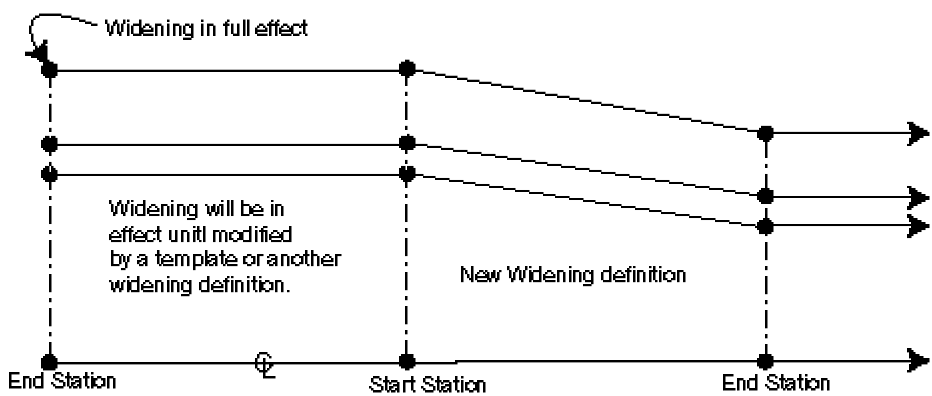


Figure 4 Widening to Widening Transition

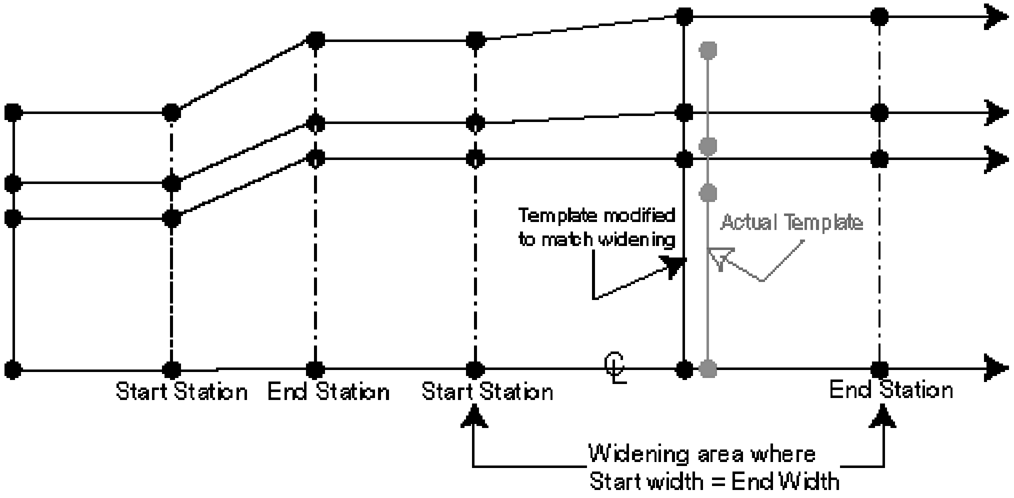


Figure 5 Template Inserted Into A Widening Area

Figure Descriptions

Figure 1 shows an overhead view of a simple transition from one template to another. Notice the linear transition of one template segment end node to the next.

Figure 2 shows an overhead view of a basic template to widening transition. The widening's first segment width for the start station must match the first segment width of the previous template.

Figure 3 shows a transition from a widening to a template. This example shows that a widening basically defines a new template that has a modified first segment. The modified template (widening) will transition to the next template down the road.

Figure 4 shows the same concept as Figure 3 except another widening is used instead of a template.

Figure 5 depicts how a template can be inserted inside a widening definition. The widening will take precedence over the first segment so the first segment will maintain the length as defined in the widening definition. However, the segments outside of the first segment now take on the shape of the inserted template. The figure shows a widening where the start width is the same as the end width but having the widening use the same start and end width is not required. The first segment of the template will be adjusted to match whatever the widening says the width of the first segment should be at the station where the template is inserted.

Also notice in Figure 5 that we have defined a widening with the start width the same as the end width. This can be a handy tool to use if you need to widen the road for a relatively long distance but also need to change the template segments outside the first segment. Using a widening as shown enables you to use any template to modify the outside segments while retaining the same roadbed (first segment) width.

Super Elevations

The examples above show how widenings interact with templates. Super elevations work with templates in the same way, except instead of the width of the first segment being modified, the cross slope for the first segment is modified.

Creating Templates

The information for a single template is stored in a separate file with a TP5 extension. Template names are limited to eight characters plus the extension so that they can be used in DOS-based data collectors. Each template stores information on the cross section for one side of the road.

A road can have as many templates as necessary, but each side of the road must only use templates with the same number of segments. Once the first template is selected, Survey Pro will only let you select from additional templates that have the same number of segments as the first template.

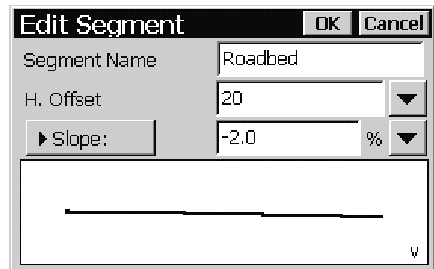
A template can be used on either side of the road. They are not right or left specific. A road could contain only one template, which would be used for both the right and left sides, but can also contain as many templates as necessary.

In this example, we will create a single template that contains a roadbed, a curb, and a ditch. Each segment will be defined in order, starting from the centerline and working toward the edge.

1. Tap [7 Roads] [A Edit Templates] to open the Add/Edit Templates screen.

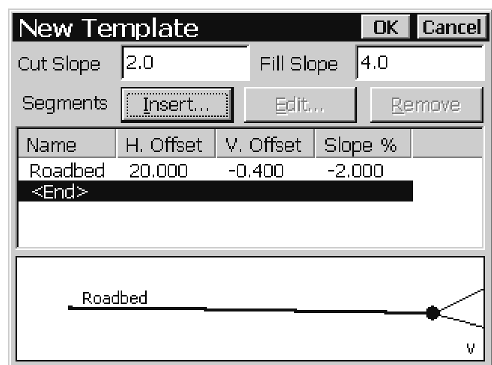
2. Tap [New...] to open the New Template screen. The Cut Slope and Fill Slope values are the slopes to compute the location of catch points with the Road Slope Staking routine. These values can also be easily changed from that routine.

3. Tap [Insert...]. This will open the Edit Segment dialog box. Enter the following information to define the first segment, which will be a 20-foot wide roadbed with a –2% slope.

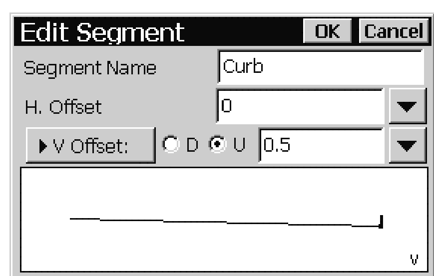


   Segment Name: **Roadbed**
   H. Offset: **20**
   Slope: **-2**

4. Tap [OK] to return to the New Template screen where the new roadbed segment will appear. A list of segments is displayed. At this point, only the roadbed and <End> will be displayed in the list. Whenever a new template it inserted, it is inserted above the template that is selected in this list. Therefore, to add a new segment to the end of the last segment, <End> should be selected prior to tapping [Insert...].



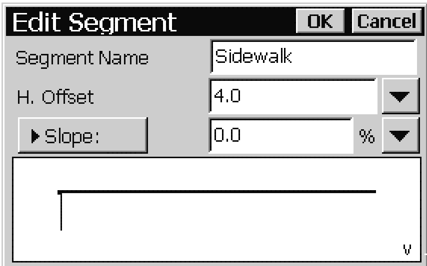
5. With <End> selected, tap [Insert...] and enter the following data to add a new segment that will describe the face of a curb. Notice for the last field, you need to toggle the [▸ Slope] button to [▸ V. Offset] and select the ⊙U radio button to specify that the curb extends upward.



   Segment Name: **Curb**
   H. Offset: **0**
   V. Offset: **⊙U 0.5**

6. Tap OK to return to the New Template screen where the new curb segment will appear.

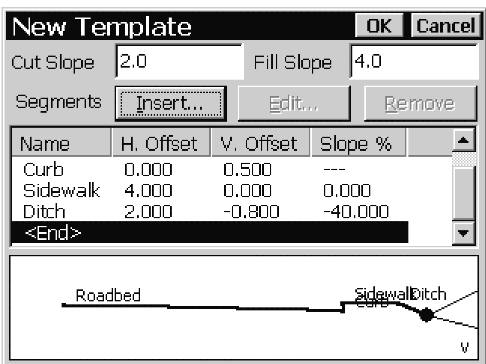
7. With <End> selected, tap Insert... and enter the following data to add a sidewalk and then tap OK.



Segment Name: **Sidewalk**
H. Offset: **4**
Slope: **0**

8. With <End> selected, tap Insert... and enter the following data to add a ditch and then tap OK.

Segment Name: **Ditch**
H. Offset: **2**
Slope: **-40**



9. Tap OK from the New Template screen and the Save As dialog box will open. Enter **T1** in the Name field and tap OK. This completes the creation of a template.

Building an Alignment

The Edit Alignments routine is used to create an alignment and is explained in detail starting on Page 39. If you do not currently have any alignments stored on the data collector, either create a simple alignment now that is at least 300 feet long, or follow the instructions that start on Page 39 to create a new alignment that contains each possible type of horizontal and vertical section.

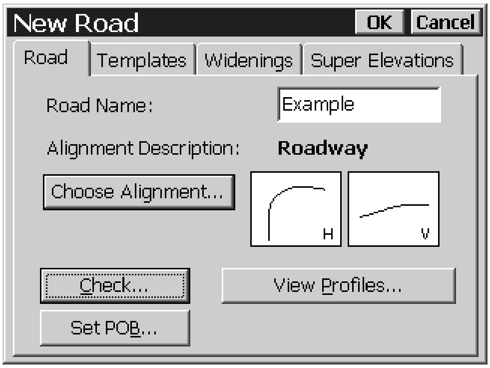
Putting the Road Together

The final step in creating a road that can be point staked or slope staked is to use the Add/Edit Roads routine to combine the template(s) with the alignment and define any widenings and super elevations.

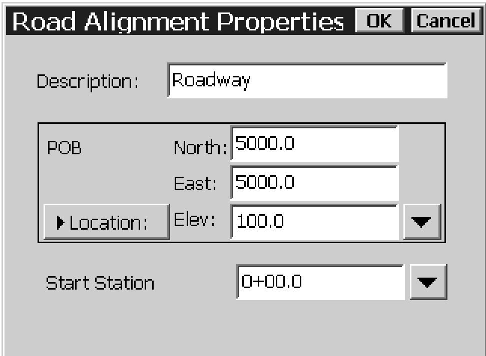
In this example, we will use only one template for the entire road. We will use a widening to add a second lane to the right side of the road and we will add four super elevation definitions to bank the left and right side of a curve.

Add Templates to the Alignment

1. Tap 8 Roads C Edit Roads to open the Add/Edit Roads screen.



2. Since we are creating a new road, tap New... to open the New Road screen.
3. With the Road tab selected, enter a name for the road in the Road Name field. In this example, we used **Example**.
4. Tap the Choose Alignment... button and select an alignment. In this example, we selected the Roadway alignment created on Page 39. Tap OK to continue.
5. Tap the Set POB... to open the Road Alignment Properties screen to define where the road begins in the job.



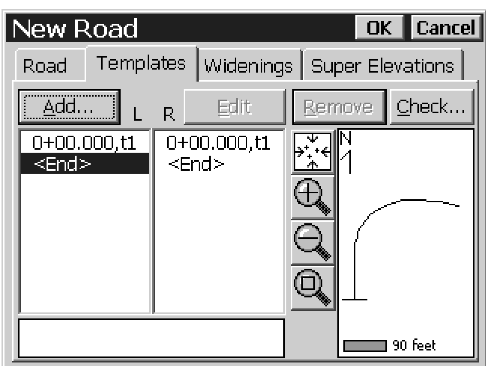
6. Enter the following data then tap OK:

   North: **5000**
   East: **5000**
   Elev: **100**
   Start Station: **0+00**

7. The next step is to add the templates. We will use the template created earlier to define both sides of the road. Tap the Templates tab.

8. With <End> selected in the **L**eft column, tap the Add... button. This opens the Add Left Template screen, which allows you to add a template to the left side of the road.

9. All the available templates will be displayed in the Template column. Select the T1 template, created earlier.



10. Since we will use this template for both sides of the road, check the ☑ Mirror to Right checkbox and tap OK. We now have the minimum number of components to completely define a road: an alignment, and a left and right template.

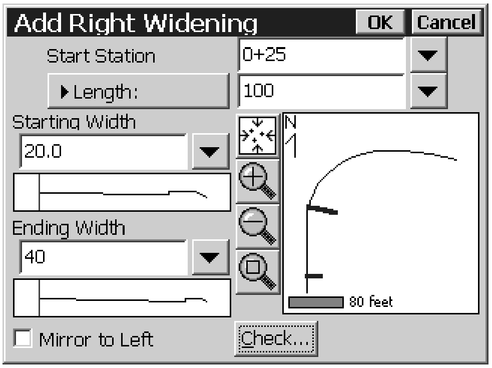
11. Tap Check... to confirm that the road is okay. You should get a message stating success.

> **Note**: once templates have been added, you can return to the Road card and tap the View Profiles... button to view the cross-sectional profile of the road at any station.

Add Widenings

12. Tap the Widenings tab. We will define a widening where a new lane will begin in the right side of the road.

13. Tap <End> in the **R**ight column and then tap the Add... button. This opens the Add Right Widening screen, which allows you to add a widening to the right side of the road



14. In the Start Station field, enter 0+25. This is where the widening will begin.

15. The length of the widening is 100 feet so toggle the ▸ End Station button to ▸ Length and enter **100**.

16. The starting width of a widening must equal the width of the first segment of the template that leads into the widening, or if a previous widening leads into it, it must equal the width of the previous widening. Leave the Starting Width field set to its default value of 20.

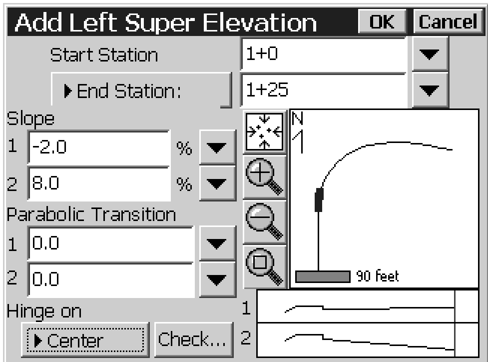
17. Since we are adding a lane with this widening, enter **40** in the Ending Width field. This widening will now begin at 0+25 and over a 100-foot span; the first segment of the template will increase in width from 20 feet to 40 feet. Bold lines in the map view illustrate the beginning and ending widths of the widening.

18. Tap OK to continue.

Add Super Elevations

19. Tap the Super Elevations tab where we will insert a super elevation at the beginning and end of a curve for the left and right sides of the road.

20. With <End> selected in the **L**eft column, tap the Add... button. This opens the Add Left Super Elevation screen, which allows you to add a super elevation to the left side of the road.



21. We will start the super elevation 100 feet from the beginning of the road so enter **1+00** in the Start Station field.

22. The super elevation will be at the final slope after 25 feet so enter **1+25** in the End Station field.

23. The start slope must be the same as the slope of the first segment of the template that leads into the super elevation, so leave the Slope 1 field set to -2.

24. We want the ending slope to be 8% so in the Slope 2 field, enter **8** for simplicity, we will not use parabolic transitions so leave those fields set to 0.

25. Most super elevations hinge at center so be sure the Hinge on field is toggled to Center and then tap OK to continue. This will complete the super elevation for the beginning of the curve on the left side of the road.

26. We now need to add a super elevation at the end of the curve on the left side of the road to change the slope back to -2%.

27. With <End> selected in the **L**eft column, tap the Add... button again.

28. From the Add Left Super Elevation screen we will start the transition out of the super elevation 200 feet from the beginning of the road so enter **2+00** in the Start Station field.

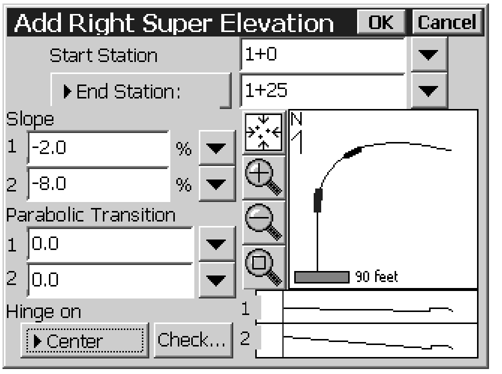
29. The super elevation will return to the original slope after 25 feet so enter **2+25** in the End Station field.

30. The start slope must be the same as the slope of the road where it leads into the super elevation, so leave the Slope 1 field set to 8.

31. We want the ending slope to be -2% so in the Slope 2 field, enter **-2**. Leave the parabolic transition fields set to 0.

32. Be sure the Hinge on field is toggled to Center and then tap OK to continue. This will complete the super elevation entries for the left side of the road.

33. We now need to repeat the above steps for the right side of the road. Tap <End> in the **R**ight column to select that side of the road and then tap the Add... button to open the Add Right Super Elevation screen.



34. Enter the following data just as you did for the left side of the road and then tap OK.

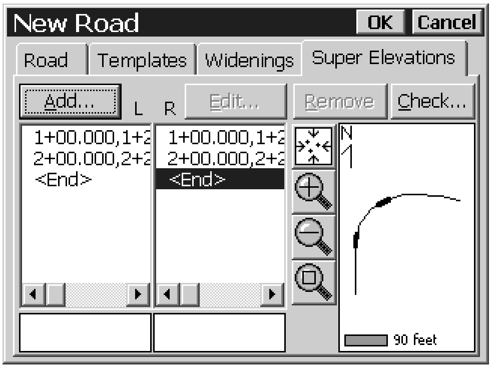
    Start Station: **1+0**
    End Station: **1+25**
    Slope 1: **-2**
    Slope 2: **-8** (notice this is a negative value)
    Parabolic Transition 1: **0.0**
    Parabolic Transition 2: **0.0**
    Hinge on: **Center**

35. With <End> selected in the **R**ight column, tap the Add... button again to add the final super elevation.

36. Enter the following data to describe the second super elevation on the right side of the road and then tap OK.

    Start Station: **2+0**
    End Station: **2+25**
    Slope 1: **-8**
    Slope 2: **-2**
    Parabolic Transition 1: **0.0**
    Parabolic Transition 2: **0.0**
    Hinge on: **Center**

37. This completes the definition for an entire road including templates, widenings and super elevations. To make sure there are no errors, tap Check.... You should get a message stating success.



38. Tap OK to save the road. Do **NOT** tap Cancel at this point or you will have to start over.

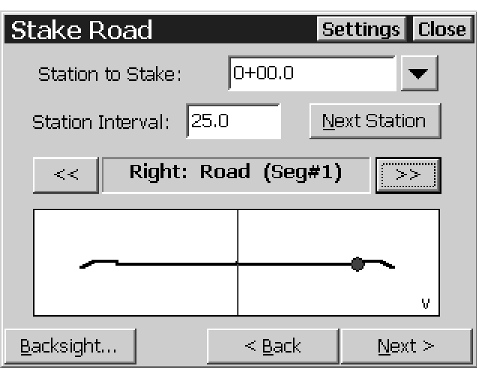
You are now ready to stake the road in the field. Close any open windows to return to the Main Menu.

Staking the Road

With your road fully designed, you are now ready to stake the road. Staking a road is a simple and intuitive process. If you are familiar with point staking, you should be able to easily stake a road.

This section explains how to get started using the Stake Road routine and then refers you to the point staking example when the screens become identical.

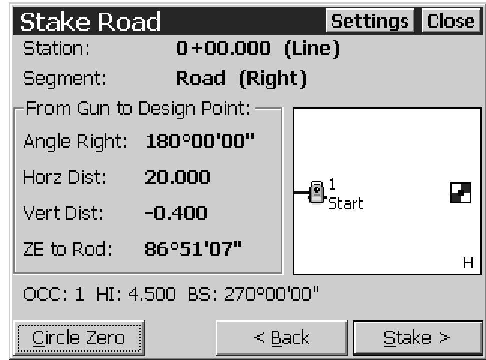
1. Tap [8 Roads] [D Road Stakeout] to open the Stake Road screen.
2. Tap the [Tap Road...] button to open the Tap on a Road screen. All of the roads that exist in the current job will be displayed.
3. Tap on the road that you want to stake and then tap [OK]. When the road is selected, it will be drawn with a bold line.
4. If the backsight is not yet defined, tap the [Backsight...] button to set up your backsight.
5. With the road selected and the backsight set up, tap [Next >] to continue. The next screen that opens shows the profile of the road at the starting station.



6. In the Station to Stake field, enter the station that you want to stake and in the Station Interval field, enter the distance that you want the Station to Stake to advance when you are ready to stake the next station.
7. Use the [<<] and [>>] buttons to select the node (the segment end point) on the template shown in the graphic area of the screen that you want to stake at the current station. Each press of either of these buttons will advance the selection to the next node and display the name of the selected segment in the middle of the screen. The selected node is show in the graphic portion of the screen as a circle.
8. Once the correct station to stake is entered and the desired node is selected, tap the [Next >] button to continue.

9. The next screen that opens is identical to the screens used in point staking, since that is essentially what is occurring at this point. If you are not familiar with Point Staking, refer to Page 59.

10. Once the point is staked and stored, you will return to the screen described above where a new node can be selected and staked or the station to stake can be advanced by the station interval by tapping the Next Station button.



Slope Staking the Road

The road slope staking procedure is nearly identical to the non-road layout slope staking routine described on Page 114. The main difference is the road layout templates can contain more segments, which slightly modifies the options of where the hinge point should be located in a situation where a fill is required.

Like with the road stakeout example above, this example describes how to set up road slope staking and then refers you to the non-road layout example where the screens are identical.

1. Tap 8 Roads E Slope Staking to open the Road Slope Staking screen.

2. Tap the Tap Road... button to open the Tap on a Road screen. All of the roads that exist in the current job will be displayed.

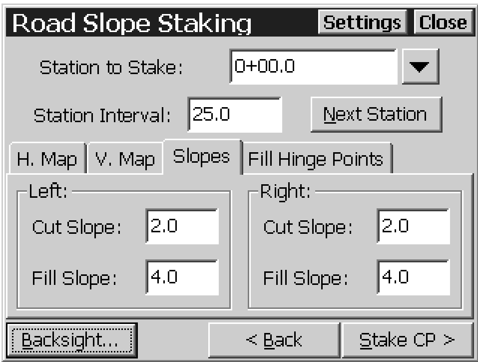
3. Tap on the road that you want to stake and then tap OK. When the road is selected, it will be drawn with a bold line.

4. If the backsight is not yet defined, tap the Backsight... button to set up your backsight.

5. With the road selected, tap Next > to continue.

6. In the Station to Stake field, enter the station that you want to slope stake and in the Station Interval field, enter the distance that you want the Station to Stake to advance when you are ready to slope stake the next station.

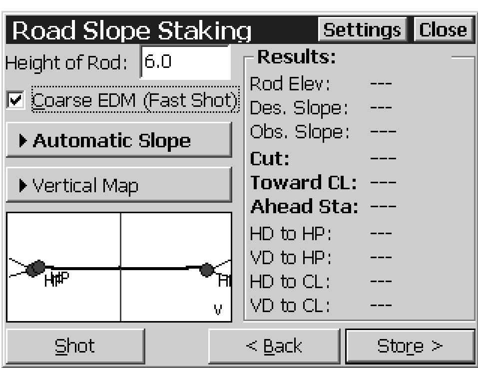
7. The H. Map and V. Map tabs are used to view information about the horizontal and vertical details of the road at the current station. Tap the Slopes tab to set up your slopes.



8. Four separate slopes can be defined for situations requiring a cut or situations requiring a fill, and can be different on the right and left sides of the road. Fill in the slopes that apply to your particular job. (The fill slopes do not need to be entered as negative values since Survey Pro knows that these are negative slopes.)

9. Tap the Fill Hinge Points tab to define where the hinge point will be computed in areas that require a fill. Some people prefer to compute this point somewhere other than the end of the last segment to simplify the situation where a ditch meets an area requiring a fill, which would otherwise result in an area with two similar or identical negative slopes.

10. Use the << and >> buttons to select the segment where you want to compute the hinge point in situations requiring a fill for each side of the road. (The hinge point will be computed at the end of the segment listed here.)



11. Tap the Stake CP > button to continue to the next screen where the catch points at the current station can be located. This screen is identical to the screens used in the non-road layout slope staking routine. If you are not familiar with these screens, refer to Page 118.

12. Once the catch point is staked and stored, you will return to the screen described above where the station to stake can be advanced by the station interval by tapping the Next Station button and the process can be repeated to stake the next catch points.

DTM Stakeout

The Stake DTM routine allows you to stake an area and get cut, fill, and volume information between the surface being staked and a reference DTM surface. You can also obtain volume information between the surface being staked and a specified reference elevation.

Create a DTM or DXF File

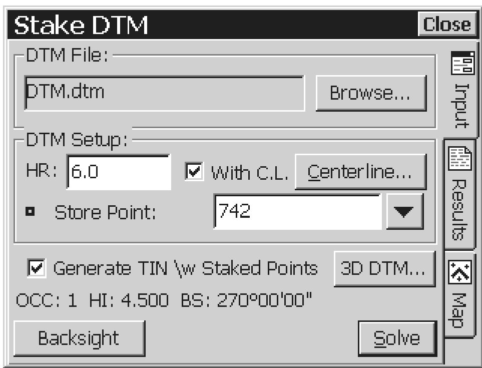
DTM Stakeout requires either a DXF file that contains a triangulated irregular network (TIN), or a digital terrain model (DTM) file for the area that you plan to stake, which is typically created from a previous topo job. Either of these files allows Survey Pro to compute the elevation information at every location within the boundary of the original topo.

TDS ForeSight can be used to create a DXF file containing the correct information from a JOB file. It provides several options for the information that is written to the DXF file, but all the options will include the required 3-D Face, or TIN information when exporting to a DXF file. Both TDS ForeSight and Survey Link will export a DTM file from a DXF file.

Note: The speed performance of the Stake DTM routine is enhanced when using a DTM file as opposed to a DXF file.

Set Up the Job

Once you have created the necessary DTM or DXF file and loaded it in the data collector, you are ready to set up your job.



1. From the Main Menu, tap 4 Stakeout K Stake DTM to open the Stake DTM screen.
2. Tap Browse... and select the DXF or DTM file for the area that you want to stake.

Warning: If importing a DXF or DTM file where the distance units in the source file are different than the distance units for the current job, the imported coordinates will be converted to the current job's distance units when they are imported. This is normally the desired result, but it can cause a problem if the distance units for the imported data or the current job were set incorrectly. This situation can most commonly occur when working with Feet and US Survey Feet, where the conversion from one to the other is not always obvious.

Usually the difference between Feet and US Survey Feet is negligible (2 parts per million), but when dealing with State Plane or UTM mapping plane coordinates, which are often very large in magnitude, the difference can be substantial if the coordinates are converted from one format to the other.

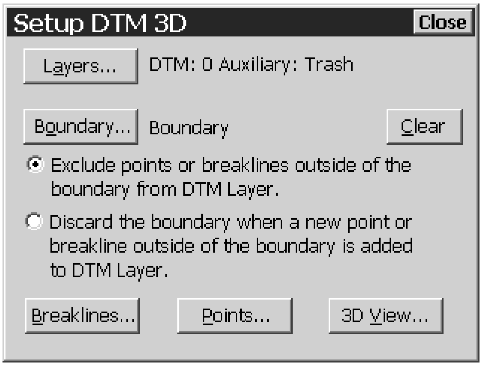
If importing coordinates from a source where you are not sure if the units are in Feet or US Survey Feet into a job that is set to Feet or US Survey Feet, you will usually just want to import them without any conversion being performed. To do this, be sure to select the same distance units for the source file as those set for the current job.

3. Enter the rod height in the HR field and the name for the first point that is stored in the Store Point field. Future points are stored with the next available point names.

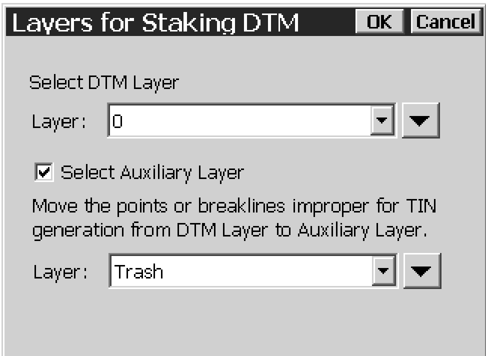
4. You have the option of selecting a centerline and get offset and stationing information for the staked points. Checking the With C.L. checkbox and then tapping the Centerline button will open the Select Line screen where you can select an existing polyline or alignment that defines a centerline. This information will also be displayed graphically in the DTM Shot screen.

5. When the Generate TIN w\Staked Points box is checked, a TIN will be generated from the points that have been staked. This is necessary if you want to view the surface from the points staked in the 3D View screen. This must also be checked if you want to get live cut / fill and volume values for the points staked. When unchecked, the 3D View is unavailable, no volumes will be computed, and cut / fill values cannot be viewed, but are still stored to the raw data file.

   When you check the Generate TIN w\Staked Points box, the Setup DTM 3D screen will automatically open, which is primarily used to set up your layers and a boundary.



Select Your Layers



6. Tap Layers... to open the Layers for Staking DTM screen.
   a. Select the layer that you want to use for the points that are valid for TIN generation from the first dropdown list.
   b. Check the Select Auxiliary Layer checkbox to automatically store any points or break-lines that cannot be used for TIN generation to a specific layer and then select the layer from the lower dropdown list. Examples of invalid objects would include a polyline that extends outside the boundary or a point with identical coordinates to another point, but with a different elevation. Leaving this box unchecked will result in a prompt to select a layer when an invalid object is to be stored.
   c. Tap OK to return to the Setup DTM 3D screen.

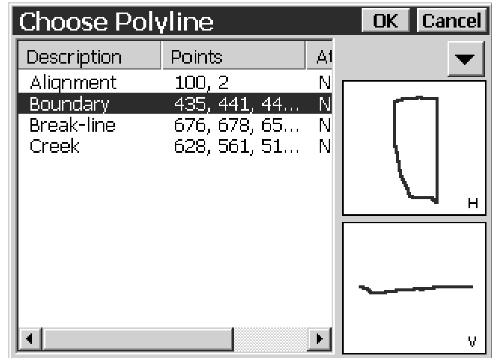
Select a Boundary (optional)

You can optionally define a boundary using a closed polyline for the points that are staked, which will limit the computation of the TIN surface within the selected boundary.

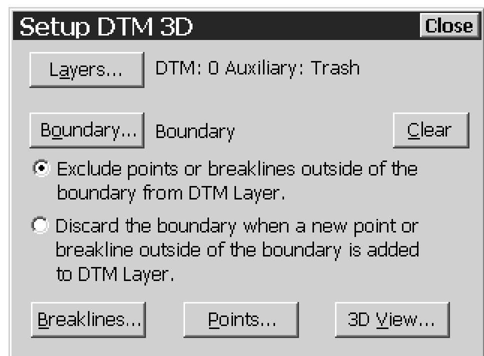
A valid polyline must be closed, and the line must not cross over itself, such as in a figure eight.

7. To select a boundary, tap the Boundary... button, which will open the Choose Polyline screen.

a. All the polylines in the current job are displayed. Select the appropriate polyline and tap OK to return to the Setup DTM 3D screen.



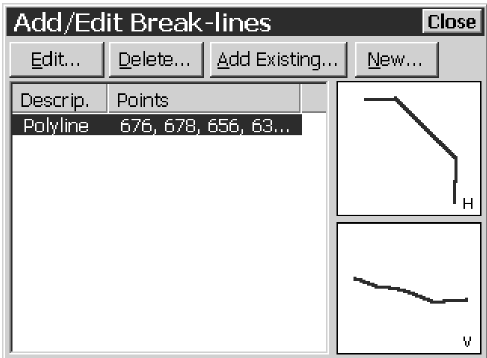
8. If a boundary is used, you must also select one of the two radio buttons in the Setup DTM 3D screen:



- **Exclude points…**: will move any objects that occur outside the selected boundary to the Auxiliary layer.
- **Discard the boundary…**: will initially move any points that exist outside the boundary to the Auxiliary layer. If a point is later stored outside the boundary, the selected boundary is automatically unselected.

Select any Break-lines (optional)

Break-lines are used to define any linear surface that has an abrupt elevation change, such as a trench, or the face of a cliff. Break-lines are necessary for an accurate TIN to be created for these surfaces. Polylines or alignments are used to define any number of break-lines, but if a boundary is used, the entire break-line must fall inside the boundary – if any part of a break-line touches the boundary, the break-line is invalid.



9. To select a break-line, tap the Breaklines... button to open the Add/Edit Break-lines screen. If any break-lines have already been selected, they will be listed in this screen.

   a. To add an existing break-line, tap the Add Existing... button. This will display all the polylines in the current job. Select the desired polyline and tap OK. This will move the selected polyline to the DTM layer.

   b. When finished adding break-lines, tap Close to return to the Setup DTM 3D screen.

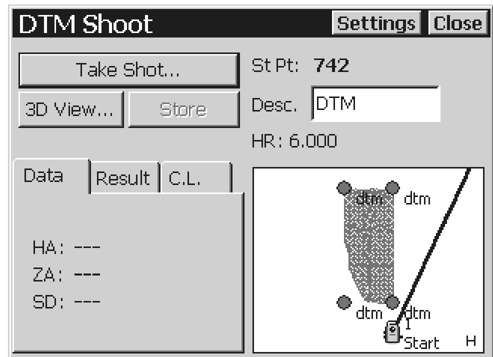
10. When you return to the Setup DTM 3D screen, the Points... button will open the Points on DTM Layer screen where the points on the DTM layer can be viewed, new points can be imported, and existing points can be deleted (moved to the Auxiliary layer). The 3D View... button will open the 3D View screen where the DTM surface for the points on the DTM layer can be viewed from any angle.

11. This completes the Stake DTM set up procedure. Tap Close from the Setup DTM 3D screen to return to the Stake DTM screen.

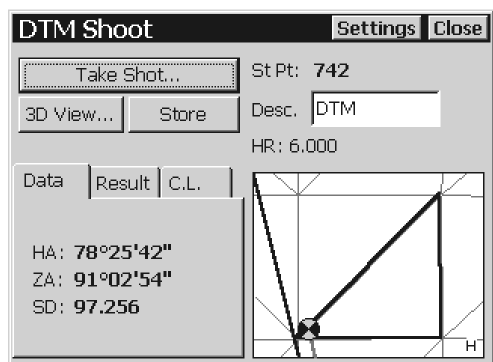
Stake the DTM

12. With the information correctly entered in the Stake DTM screen, tap Solve to continue.

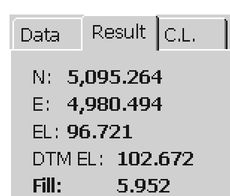
13. The DTM Shoot screen will open with a graphic that shows the DTM boundary, the reference DTM surface, the centerline if used, the occupy point, and backsight direction. Tap the Take Shot... button to take a shot.

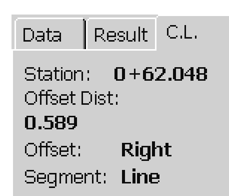


14. If a shot is taken when the prism is located within the boundary (if selected earlier) the graphic will change and the Data and Result cards will be filled in. The graphic will show the current triangle in the reference DTM surface where the rod is located and a centerline and offset, if selected earlier.

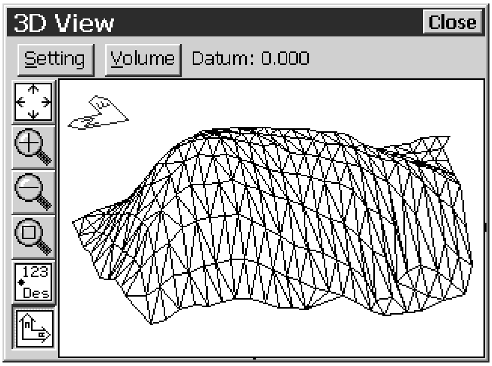


15. At anytime, you can view the current DTM surface computed from the points staked so far by tapping the 3D View... button. The Store button will store the last point staked. The Result card displays additional information about the last stake point and the C.L. card displays information related to the last stake point in relation to the centerline, if selected earlier.





View the DTM



16. Tap 3D View... to access the 3D View screen. While staking points, you should periodically tap this button to view what the current DTM surface looks like. This is a useful quality assurance technique to determine where additional points are needed.

> **Note**: The 3D View... button is only available when Generate TIN w\Staked Points is checked in the Stake DTM screen and at least three stake points have been stored.

When the button is activated (pressed in), dragging within the 3D View will result in the image being rotated to any angle. When the button is not activated, dragging within the 3D View will move the image to any location.

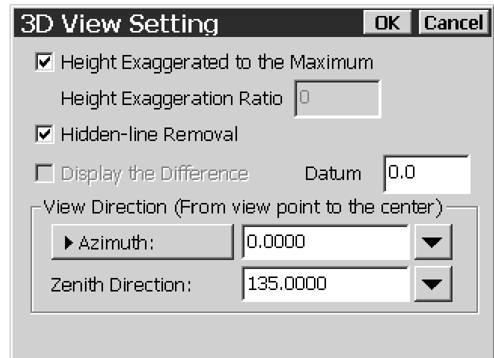
The Volume button will display the total cut and fill volume between the area that has been staked and a reference datum, whose elevation is displayed in the Datum field and is set in the 3D View Settings screen; or the total cut and fill between the area that has been staked and the selected DTM.

> **Note**: The cut and fill values accessed from the Volume button are volumes, where the cut and fill values represented in the Result card of the DTM Shot screen are vertical distances.

The button toggles to display or hide the point names and descriptions in the 3D view.

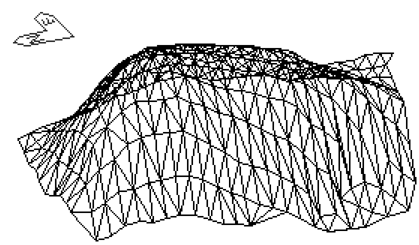
Datum: displays the datum elevation set in the 3D View Settings screen.

17. Tap the Setting button at the top of the screen to access the 3D View Setting screen to configure the information displayed in the 3D View screen.



When **Height Exaggerated to the Maximum** is checked, the height exaggeration is automatically set to a high value. When unchecked, the height exaggeration can be set manually in the next field.

Height Exaggeration Ratio: is the value that the height is multiplied by in the 3D view. The higher this value, the more exaggeration, where 1.0 would result in no exaggeration.



When **Hidden-line Removal** is checked, all the lines that occur behind other surfaces in the 3D View screen will be hidden. The image shown here is identical to the image shown in the screen above except the hidden lines are not removed.

When **Display the Difference** is checked, the elevations in the 3D View screen will be distorted so the reference DTM becomes a flat surface. This will result in any staked points that occur above or below the reference DTM to clearly stand out as hills and valleys and the volume information provided in the 3D View screen will be between the staked points and the reference DTM.

When the Display the Difference checkbox is unchecked, the **Datum** field can be set to a reference elevation. Cut and fill volumes in the 3D View screen will then be based on the difference of a horizontal plane at the elevation specified here and the staked points.

The **View Direction (from view point to the center)** settings allow you to specify the exact horizontal and vertical angle in which to view the DTM surface.

18. Tap OK from the 3D View Setting screen to return to the 3D View screen.

19. Tap Close from the 3D View screen to return to the DTM Shot screen. From there you can continue taking DTM stake shots.

Screen Examples

This section describes how to use several of the routines in Survey Pro. Each example outlines the procedure to use a particular screen. The examples are written in a general way so the user can use their own data to become familiar with the routine.

Import / Export Coordinates

The Import Coordinates routine allows you to add the coordinates from any job to the current job.

The Export Coordinates routine allows you to export any coordinates from the current job to a new job.

These routines provide full compatibility between older TDS file formats.

Warning: Importing coordinates from any source other than a JOB file requires that the distance units used in the source file be specified. It is not necessary to specify the distance units when importing coordinates from a JOB file since those units are written within the file.

If importing coordinates where the distance units in the source file are different than the distance units for the current job, the imported coordinates will be converted to the current job's distance units when they are imported. This is normally the desired result, but it can cause a problem if any distance units were set incorrectly. This situation can most commonly occur when working with Feet and US Survey Feet where the conversion from one to the other is not always obvious.

Usually the difference between Feet and US Survey Feet is negligible (2 parts per million), but when dealing with State Plane or UTM mapping plane coordinates, which are often very large in magnitude, the difference can be substantial if the coordinates are converted from one format to the other.

If importing coordinates from a source, such as an HP 48, where you are not sure if the units are in Feet or US Survey Feet into a job that is set to Feet or US Survey Feet, you will usually just want to import them without any conversion being performed. To do this, be sure to select the same distance units for the source file as those set for the current job.

Importing *.JOB Coordinates

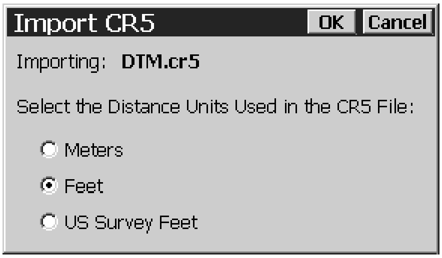
The steps below will add the coordinates from any existing job (CR5 or JOB) to the current job.

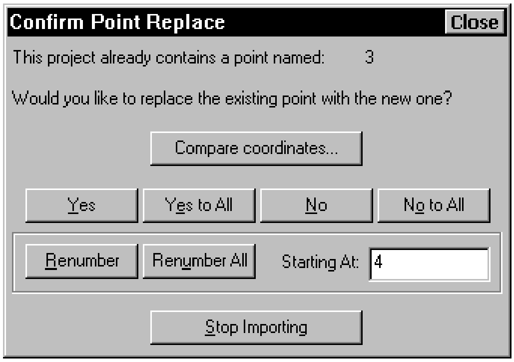
1. With the job open that you want to add points to, select [1 File], [C Import Coordinates].
2. In the Type field of the Import Coordinates screen, select Job Files (*.job).
3. Tap the desired JOB file that you want to import and then tap [OK].

Importing *.CR5 Coordinates

The steps below will add the coordinates from any existing job (CR5 or JOB) to the current job.

1. With the job open that you want to add points to, select [1 File], [C Import Coordinates].
2. In the Type field of the Import Coordinates screen, select Coordinate Files (*.cr5).
3. Tap the desired CR5 file that you want to import and then tap [OK].
4. The Import CR5 dialog box will open where you must specify the distance used in the file being imported. Select the correct distance and then tap [OK]. (See warning above.)



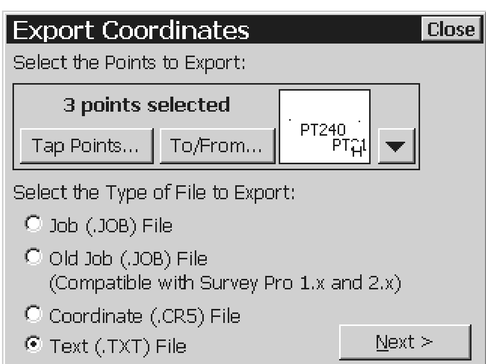


If any of the point names in the source file match a point name already in the current job, the Confirm Point Replace dialog box, shown here, will open asking you what you want to do. Make the desired choice to continue.

If a duplicate point is encountered (duplicate name **and** coordinates), it will be ignored.

Exporting Coordinates

The steps below will copy selected points from the current job to a new job in a specified file format.



1. Select [1 File], [D Export Coordinates] to open the Export Coordinates screen.
2. You can select the desired points to export using any of the following buttons:
   - [Tap Points...] allows you to select points by tapping them from a map view.
   - [To/From...] allows you to specify a range of points to export.
   - [▼] allows you to select all points; select all control points; or select points by their description.
3. Select the radio button that corresponds with the file format that you want to export.
   - If a JOB format file was selected, tap [Export].
   - If a CR5 format file was selected, tap You must then specify if you want to create a Sequential or Non-Sequential file.

Note: The HP-48 platform can only open sequential CR5 files.

- If a TXT format file was selected, tap Next>. This will lead to two additional screens where the desired format of the text file is configured. For an explanation of the available options, refer to the Reference manual.

4. The Save As dialog box will open. Specify a file name for the new file in the Name field and tap Save. (The file extension is automatically added for you.)

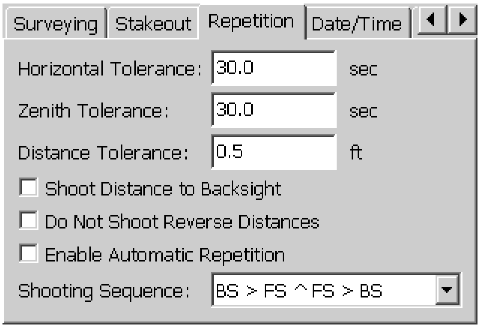
Repetition Shots

A repetition "shot" consists of one or more *sets*. A set consists of four individual shots; direct and reverse shots to a backsight and a foresight. The result of a repetition shot is to store the foresight point using average coordinate values that are computed from all the shots taken.

Repetition shots can be performed with a variety of options. This section explains how to perform a repetition shot and the different options available.

Repetition Settings Screen

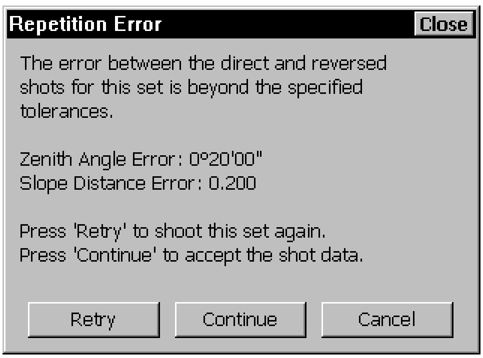
The Repetition Settings screen is used to define the method that you will use when performing repetition shots. It includes acceptable tolerance values between the direct and reverse shots for each set and the desired shot sequence. The Repetition Settings must be set before you start taking shots.



1. Select 2 Job, A Settings from the Main Menu. (You can also tap the Settings button from the Repetition Shots screen.)

2. Tap the Repetition tab. (Use the ◄► buttons to expose hidden tabs.)

3. Set the Horizontal, Zenith, and Distance Tolerances in the appropriate fields. The direct shots for each set are compared to the corresponding reverse shots. If any of the angles or distances exceeds the specified tolerances, the <u>Repetition Error</u> dialog box, shown here, will open that asks what you want to do. You have the following choices:



   - Retry: Re-shoot only the last set.
   - Continue: Continue and use the shot anyway.
   - Cancel: Throw out all sets and start over.

4. If the Shoot Distance To Backsight checkbox is selected, distances will also be measured with each shot to the backsight and compared against the specified Distance Tolerance. This option, of course, would require a prism to be setup over the backsight point.

5. The Do Not Shoot Reverse Distances checkbox is available for people that use total stations that cannot measure distances when in the inverted, face two, position. Check this if you use this type of total station.

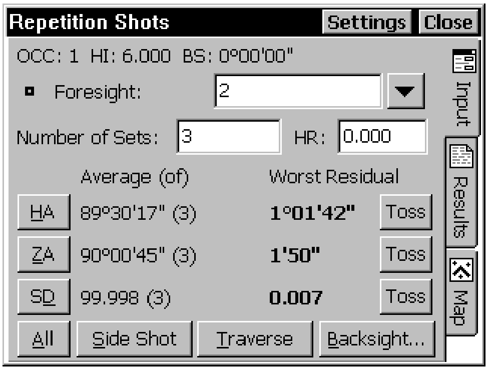
6. The Enable Automatic Repetition checkbox is for users with motorized total stations. When this is checked, the first shot to the backsight and foresight is performed normally, but when those shots are complete the total station will perform all the remaining shots for each set automatically unless the user interrupts the sequence.

7. The Shooting Sequence defines the order that the forward and reverse shots are performed for each set. The notation used should be read where the > symbol indicates to aim the telescope to the next point and the ^ symbol indicates that the total station should be flopped from face one to face two or vice versa. Each option is explained below.

- BS > FS ^ FS > BS: Shoot backsight, shoot foresight, *reverse scope*, shoot foresight, shoot backsight
- BS > FS ^> BS > FS: Shoot backsight, shoot foresight, *reverse scope*, shoot backsight, shoot foresight
- BS ^ BS > FS ^ FS: Shoot backsight, *reverse scope*, shoot backsight, shoot foresight, *reverse scope*, shoot foresight
- FS ^ FS > BS ^ BS: Shoot foresight, *reverse scope*, shoot foresight, shoot backsight, *reverse scope*, shoot backsight
- FS > BS ^ BS > FS: Shoot foresight, shoot backsight, *reverse scope*, shoot backsight, shoot foresight
- FS > BS ^> FS > BS: Shoot foresight, shoot backsight, *reverse scope*, shoot foresight, shoot backsight

Repetition Shots Screen

After the repetition settings are configured for your particular situation, the Repetition Shots screen is accessed where the actual shots are performed.



1. Select [3 Survey], [C Repetition Shots] from the Main Menu. If you have not already defined your backsight, you will need to do so before you can access the Repetition Shots screen.
2. Enter the Foresight point name, Number of Sets and HR (rod height) in the appropriate fields.
3. Tap the [All] button to start the process of shooting all of the sets using the sequence selected in the Repetition Settings screen.
4. Prompts will open after every shot that instruct you on which point to shoot next and when you when you need to flop the scope.

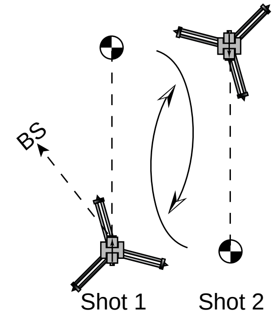
If at least three sets were performed, the Average (of) and Worst Residual fields will be filled in after the final shot is taken. The Average (of) values are simply average measurements for all of the shots taken. The Worst Residual is the angle or distance measurement that varied the most from the average from all the shots taken.

5. *Optional* – The particular measurement with the worst residual can be removed and consequently not used when computing the coordinates for the foresight point by tapping the corresponding Toss button. After tossing a measurement, the Average (of) and Worst Residual values are recomputed (assuming there is still data from at least three shots remaining).

6. *Optional* – You can re-shoot the specified number of sets, and only collect the horizontal angle, zenith angle, or slope distance from all the shots by tapping the HA, ZA, or SD button, respectively. This will replace all of the current shot data only for the selected data type with new data. You can even change the number of sets before shooting the new data.

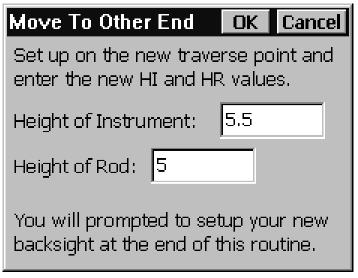
7. Once you are satisfied with your shot data, tap Side Shot to store the new foresight point as a side shot, or tap Traverse to store it as a traverse shot.

Shoot From Two Ends



The Shoot From Two Ends screen is used to provide more accurate vertical closure to a traverse. The routine requires that after the foresight is shot, its location is not computed until after the foresight point is occupied and a second shot is taken to the previous occupy point. Once the second shot is complete, the coordinates for the original foresight are computed from an average of both shots.

1. From the Main Menu, select 3 Survey, L Shoot From 2 Ends. If you have not already setup your backsight, you will need to do so before the Shoot From Two Ends screen will open.
2. Fill in the screen, including the number of sets that you want to shoot from each point in the Number of Sets field.
3. Tap Traverse, aim toward the backsight and tap Take Shot.
4. Shoot the specified number of sets to the backsight and foresight. When finished, the Move To Other End dialog box will open, shown here. At this point you need to move the total station over the current foresight point, place a prism over the current occupy point, fill in the dialog and tap OK. A new screen will open.



5. Aim at the prism located over the previous occupy point and tap Take Shot. You will then need to shoot the specified number of sets to the previous occupy point.

When the final set is complete, a screen will inform you of your new occupy and backsight point and the new point will be computed and stored.

Offset Shots

Three individual screens are used to perform offset shots. These include the Distance Offset screen, Horizontal Angle Offset screen, and Vertical Angle Offset screen.

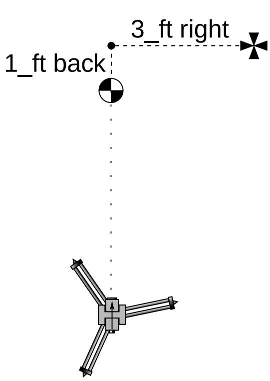
Offset shots are generally performed to compute coordinates for points that cannot easily be occupied by the rod. The offset routine that you choose will depend on your situation. Each routine is explained below.

Distance Offset Screen

The Distance Offset screen will result in the storage of a point that is located at a specified horizontal and/or vertical distance away from the current rod location.

The routine requires independent horizontal and vertical distances (offsets) that are applied to a shot from the rod location.

In the example below, a point is stored that is 3 feet to the right of the prism and 1 foot behind the prism from the point of view of the total station.



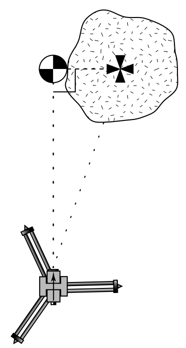
1. From the Main Menu, tap [3 Survey], [E Distance Offset]. If you have not already setup your backsight, you will need to do so before the Distance Offset Shot screen will open.
2. The rod person should measure the horizontal and / or vertical distance to the new point from the rod position. Horizontal measurements should be taken parallel and / or perpendicular to the line between the total station and the rod.
3. If the new point is to the left or right of the rod location, enter the perpendicular offset distance in the Offset field and select ⊙L if the new point is on the left side, or ⊙R to if the new point in on the right side (from the total station's point of view).

4. Enter a positive offset distance in the Horz Dist Offset field if the offset to the new point is behind the rod location (from the total station's point of view), or enter a negative offset distance if the new point is in front of the rod location.

5. If the new point is at a different elevation than the rod location, enter the a positive vertical offset in the Elevation Offset field, or a negative vertical offset if the new point is below the rod location.

6. After all the appropriate fields are filled in correctly, aim the total station at the prism and tap the Shoot button. The offset distance(s) entered will be applied when computing the coordinates for the new point and the new point will be stored as a side shot.

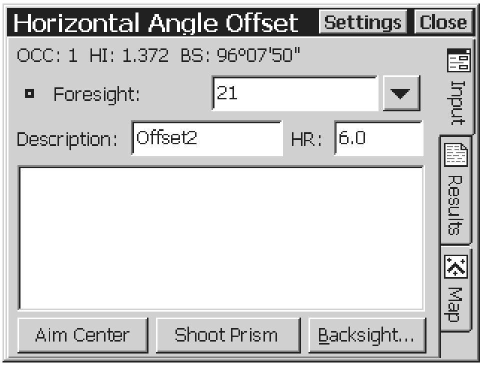
Horizontal Angle Offset Screen



The Horizontal Angle Offset screen is used to store a new point that lies on a line tangent to the rod and perpendicular to the line formed between the total station and the rod. (See illustration.) The routine requires two shots by the total station; one at the prism, located to the side of the new point; and one in the direction of the new point.

This example explains how to store a point at the center of an obstacle – such as a big tree.

1. From the <u>Main Menu</u>, tap 3 Survey, F Horz Angle Offset. If you have not already setup your backsight, you will need to do so before the <u>Horizontal Angle Offset Shot</u> screen will open.



2. The rod person should position the prism to the side of the location of the new point so that the angle formed by the new point, the prism, and total station form 90°. (See illustration.)

3. With the total station aimed toward the new point, tap the Aim Center button. Only the horizontal angle is measure during this shot so a prism does not need to be used.

4. Aim the total station toward the prism located at the side of the new point and tap

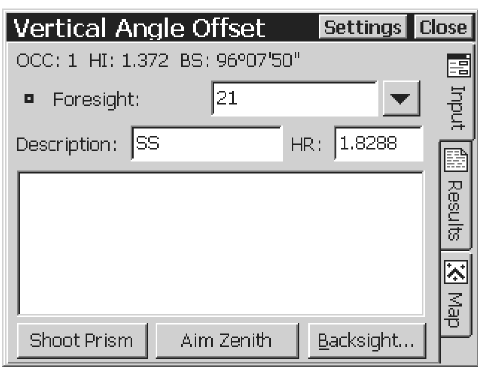
Shoot Prism. The new point will be stored as a side shot.

Note: The center shot and the prism shot can be taken in either order.

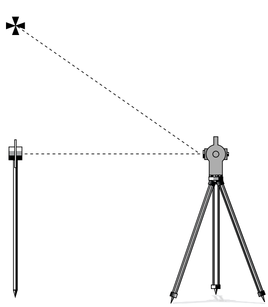
Vertical Angle Offset Screen

The Vertical Angle Offset screen is used to store a new point that is located directly above, or directly below the rod location. The routine requires two shots by the total station, one at the prism, and one in the direction of the new point.

This example explains how to store a point that is located above the rod – such as at the top of a utility pole.



1. From the Main Menu, tap 3 Survey, G Vert Angle Offset. If you have not already setup your backsight, you will need to do so before the Horizontal Angle Offset Shot screen will open.
2. With the prism positioned directly below the location of the new point, aim the total station at the prism and tap Shoot Prism.
3. Aim the total station at the new point and tap Aim Zenith. (Only a zenith angle is measured during this shot so a prism is not necessary.) A new point will be stored with the same northing and easting as the rod location, but with a different elevation.



Resection

The Resection screen allows you to occupy an unknown point and compute its coordinates by shooting two to seven known points.

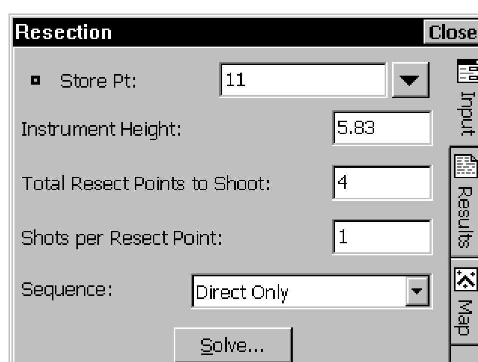
The accuracy of the computed occupy point depends on the following factors:

- The number of known points that are shot
- The accuracy of the known point's coordinates
- The position of the known points relative to the total station

To better explain this last statement, when planning the location of the total station and the known points that you will shoot, try to avoid a situation where the horizontal angle turned between two known points is either near 0° or near 180°. Both of these scenarios create large errors in the computed point when a small error is made in measuring the horizontal angle. This is particularly true when performing a two-point resection.

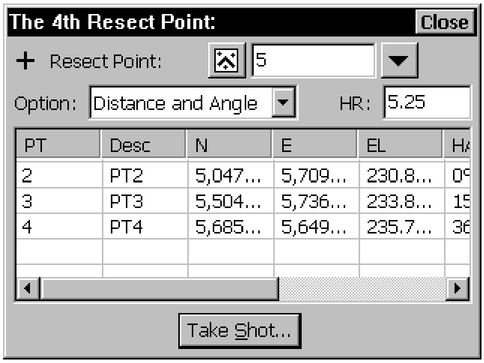
Performing a Resection

Setup the total station over the location where you want to compute coordinates. Be sure that at least two known points are in view from this location. (The known points must already be stored in the current job.)



1. Tap [3] Survey, [N] Resection.
2. Enter the occupy point name that you want to compute in the Store Pt field.
3. Enter the number of known points that are in view that you will shoot in the Total Resect Points to Shoot field. You must shoot at least two and no more than seven.
4. Enter the number of shots (forward and reverse) that you want to take to each known point in the Shots per Resect Point field.

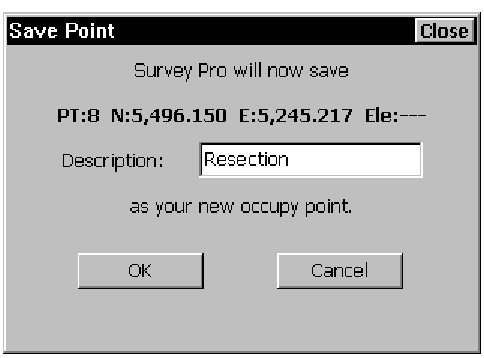
5. In the Sequence field, specify if you want to perform Direct Only shots to each known point or Direct and Reverse shots.



6. Tap Solve... after each field is correctly filled in. A new screen will open where you can shoot a resection point.
7. Enter the name of the point that you plan to shoot in the Resect Point field.
8. If you are shooting more than two resection points, you have the option of taking Distance and Angle measurements with each shot or Angle Only measurements by making the appropriate selection from the Option pull-down menu.

Note: The Angle Only option allows you to perform all shots without the use of a prism, but the resulting occupy point that is computed will not have an elevation associated with it.

9. With this screen filled in correctly, aim toward the next resection point and tap the Take Shot... button to shoot the specified resection point.



10. Repeat Steps 7 through 10 until every resection point is shot. After the final shot is completed, the Save Point screen will open where you can specify a description for the new point.
11. Tap OK to return to the Resection screen. You can tap the Results tab to view information about the stored point or the Map tap to see a graphical representation of the resection.

Solar Observations

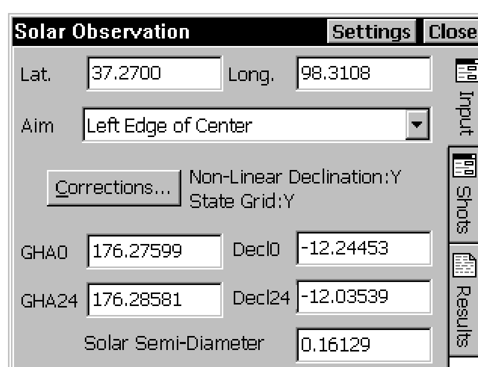
The Solar Observation screen is used to compute the azimuth to an arbitrary backsight based on the position of a celestial body, typically the sun.

You can either use the time set in the system clock on the data collector or an external timepiece. Whichever you choose, you should calibrate it against Coordinated Universal Time shortly before performing the solar observation. An accurate timepiece is critical when performing solar observations.

Two solar observation methods are available. One method requires data taken from an ephemeris and the other method does not. The example below illustrates performing a sun shot using ephemeris data since that method requires additional steps.

WARNING! Direct viewing of the sun without a proper filter will cause serious eye damage. Pointing a total station directly toward the sun without a solar filter can also damage the EDM components.

Performing a Sun Shot



1. Setup over a point with known or assumed coordinates and aim the total station at the backsight point to where you want to determine the azimuth.
2. From the Main Menu, select [3 Survey], [P Solar Observation].
3. A dialog will open asking you to select an observation method. For this example, select the Find Azimuth Using Ephemeris Data option and tap [OK].

4. Enter the latitude and longitude for your occupy point in the Lat. and Long. fields, respectively.

Note: Your latitude and longitude should have enough accuracy if it is scaled from a topographic map or measured using a handheld GPS unit.

5. In the Aim field, select the area of the celestial body where you plan to take your measurements. For sun shots, the trailing edge is usually used. (The left edge when in the northern hemisphere.)
6. Tap the Corrections... button if the correction settings displayed to the right of the button need to be changed.
   - If performing a sun shot, check the Non-Linear Declination Correction checkbox. (Leave it unchecked for star shots.)
   - Check the Correct to State Grid checkbox if you want the computed azimuth corrected to align with the local state plane coordinate system.

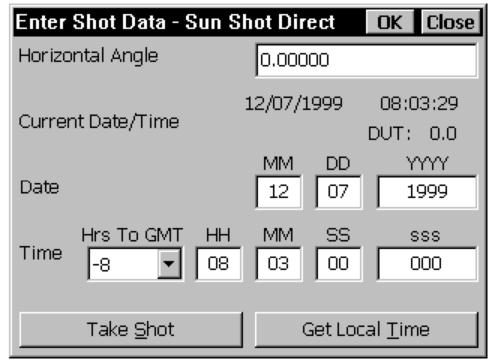
Note: The Central Meridian and Zone Constant values for the United States are provided in Appendix A of the Reference Manual.

7. Refer to a current ephemeris and fill in the remaining five values. When the screen is correctly filled in, tap the Shots tab.

Note: The GHA0 and Decl0 values are read from the ephemeris for the current date. The GHA24 and Decl24 values are listed in the ephemeris for the following day. The semi-diameter is in minutes and seconds so your value will look something like 0.16084.

8. Tap the Shoot button to open the <u>Enter Shot Data</u> screen.

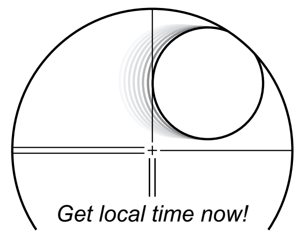
9. Enter the correct hours to GMT in the Hrs To GMT field, aim toward the backsight and tap Take Shot to record the horizontal angle to the backsight. (The azimuth to this point will be computed at the end of the routine.)



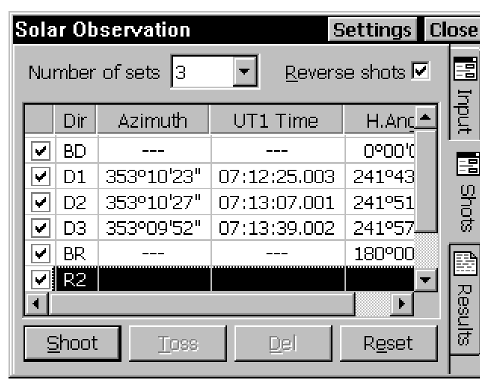
Note: The hours to GMT will be between -5 and -8 when in the continental United States.

10. **WITH A SOLAR FILTER INSTALLED**, aim ahead of the path of the sun so that the trailing edge has not yet contacted the vertical crosshair in the scope and tap Take Shot to record the current horizontal angle.

11. Watch the movement of the sun in the scope. As soon as the trailing edge of the sun contacts the vertical crosshair, either tap the Get Local Time button or use an external timepiece and note the precise time. (When using an external timepiece, manually key in the noted time in the HH, MM, SS, sss fields.)



12. Tap OK to continue. You will return to the Solar Observation screen and the computed azimuth for each shot taken is displayed with other shot information.



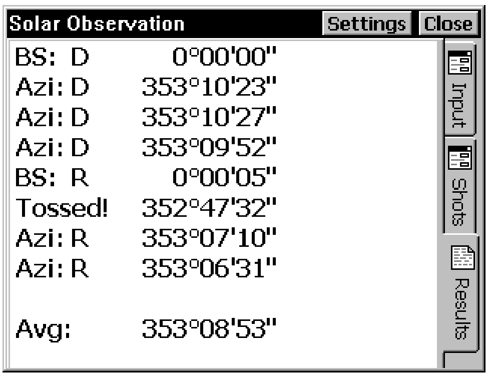
Note: You can delete and re-shoot the last shot taken by selecting it and tapping the Del button. This is useful if the last shot was in error.

13. If additional shots are remaining, the next required shot will be selected. Tap Shoot to access the Enter Shot Data screen to take the next shot.

14. Repeat Steps 10 through 12 until all forward and reverse shots have been performed.

15. After completing all shots, you can scan down the list and view the computed azimuth for each one. If any of the azimuths appear incorrect, you can have those shots excluded from the

computed average azimuth from all shots. To exclude a particular shot, select the shot and then either tap the checkbox next to the shot or the Toss button. (You can include the shot again by selecting it and re-checking the checkbox or tapping the Incl button.



16. Tap the Results tab to view the average computed azimuth to the selected backsight.

What to Do Next

With the azimuth to the backsight known, you can now perform the following steps to begin your survey.

1. Without moving from the occupy point used while performing the solar observation, note the computed average azimuth from the Solar Observation Results screen.
2. Access the 3 Survey, A Backsight Setup screen.
3. Toggle the BS Point / BS Direction button to BS Direction and enter the computed azimuth in that field.

Tip: You can use the ▼ power button and select the Past results… option to select and automatically enter the azimuth computed from the sun shot earlier.

4. Fill in the remaining fields with your current information and tap Solve.

5. Access the [3] Survey, [B] Traverse / Sideshot screen, aim toward the backsight used during the solar observation, zero your horizontal angle on the total station and tap either Side Shot or Traverse. The data collected should be aligned correctly with true north or your local state plane coordinate system.

Remote Control

Remote control mode is a special mode that makes it possible for users to control a fully robotic total station from a remote data collector.

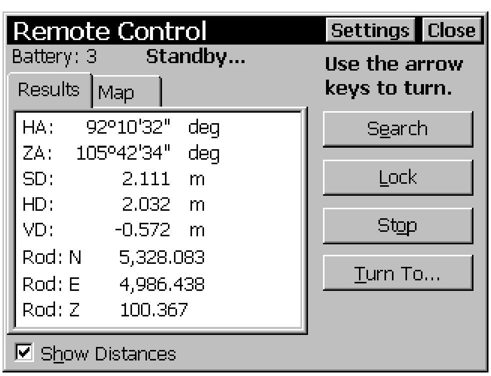
Remote control mode contains additional screens that are used exclusively with robotic instruments that perform tracking and aiming functions. The behavior of the software differs slightly in remote mode when a shot is taken and when performing stake out.

The remote control functions are available only after the robotic module is purchased, and a supported robotic total station is selected and enabled in the Settings screen.

The Remote Control Screen

The Remote Control screen is used to operate a fully robotic total station. It is used to control the total station to have a view of the prism and to activate search and tracking functions.

The Remote Control screen can be accessed in the following ways:



- Tap the Remote... button from any screen that includes it.
- Use the Ctrl-[**Y**] hotkey.
- Select 3 Survey, Q Remote Control from the Main Menu.

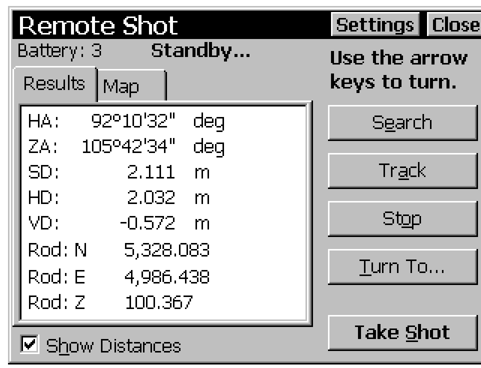
Once the Remote Control screen is open, you can perform the following functions:

You can turn the total station in any direction using the arrow keys on the keypad. As you face the total station, pressing an arrow key will start moving the total station in that direction. The total station will continue moving until the button is released. These keys are typically used to get the total station to aim in the general vicinity of the prism.

Once the total station is aiming near the prism, the Search button is used to start the total station in a search pattern. The search pattern continues until it finds the prism.

The Lock button puts the total station in track mode where it will track the movements of the prism and Stop will stop the total station from tracking the prism.

Taking a Shot in Remote Mode

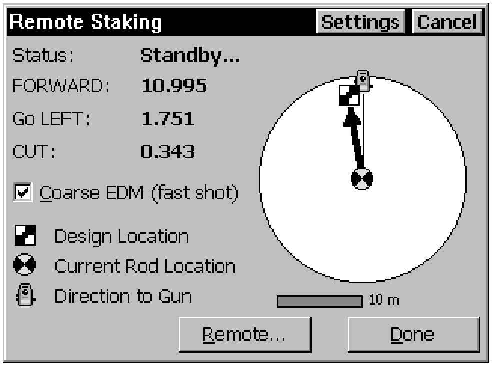


When running in a non-remote mode, tapping the Traverse or Side Shot button will simply trigger the total station to take a shot. When running in remote mode, tapping these buttons will open the Remote Shot screen, shown here.

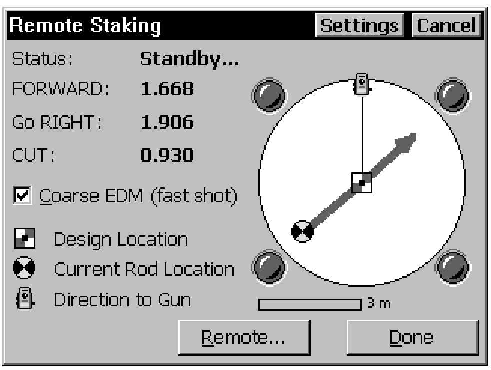
The Remote Shot screen is identical to the Remote Control screen except it has an additional button that allows you to trigger the total station to take a shot. The screen is used to properly align the total station with the prism prior to taking a shot. Once the total station is aligned, a shot is taken by tapping the Take Shot button.

If the Remote Shot screen was accessed by performing a side shot, you will return to the Remote Shot screen after the shot is completed. If the Remote Shot screen was accessed by performing a traverse shot, you will return to the Traverse / Sideshot screen after the shot is completed.

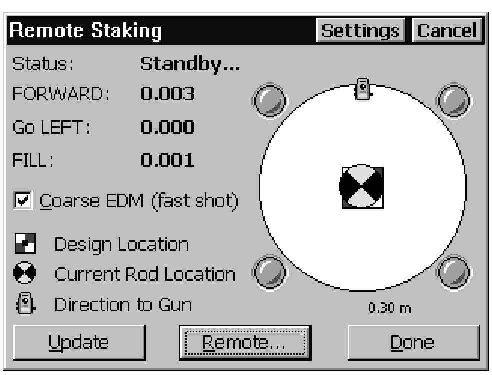
Stake Out in Remote Mode



Remote Staking Beyond 10 Feet From Target



Remote Staking Between 1 and 10 Feet



Remote Staking Within 1 Foot From Target

Performing stake out in remote mode is different from running in a non-remote mode because the feedback is continuous and provided in the rod's point of view instead of the total station's.

Stakeout data is presented in the Remote Staking screen. All of the information is displayed as if the rod person were facing the total station. The graphic portion of the screen will change depending on how close the rod is to the stake point.

When the prism is located more than 10 feet, or 3 meters from the stake point, the first screen shown above is displayed. In this situation, the prism is shown at the center of the screen and an arrow indicates the necessary direction of travel, as you face the total station.

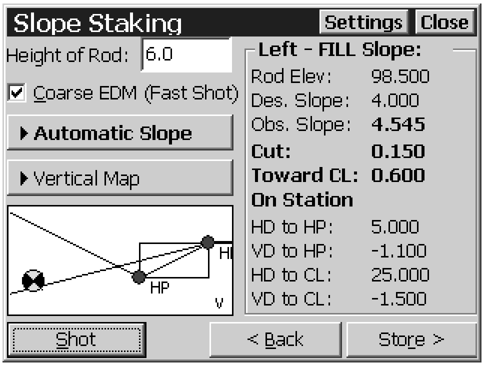
Once the prism moves to within 10 feet of the total station, the second screen, shown here, is displayed. The prism location is now at the center of the screen and the current prism location is displayed away from the center. Red "lights" are also displayed in the corners of the graphic.

When the prism is within 3 feet, or 0.3 meters of the stake point, the "lights" change to green and locating the stake point is simply a matter of moving the round prism icon directly over the square stake point icon.

When you are satisfied with the location of the prism, tap the Done button. This will open the Stake Point screen (see Page 60) where the stake point can be stored.

Slope Staking in Remote Mode

Slope staking in remote control mode functions in nearly the same way as with a non-remote total station (see Page 115). The one difference is when using the final Slope Staking screen, where the catch point is being located, the graphic portion of the Horizontal Map and Vertical Map is updated continuously. This allows the user at the rod position to watch the movement of the prism in relation to the slope and easily position the rod over the catch point.



Note: You can tap in the graphic portion of the screen to open the graphic in a larger window.

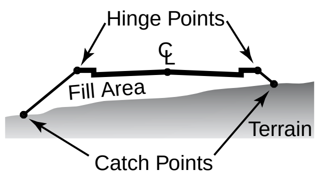
Although the graphic portion of the screen is continuously updated, the numeric values are not updated until the Shot button is tapped. This is because accurately locating the catch point depends on measuring an accurate elevation at the rod position. When the rod is moving, there is no way to estimate how far the rod is lifted off the ground. Therefore, the correct procedure for slope staking in remote mode is to use the graphic portion of the screen to locate the catch point as closely as possible, position the rod on the ground and press Shot. Once the values are updated, you can determine if the rod needs to be moved again.

Slope Staking

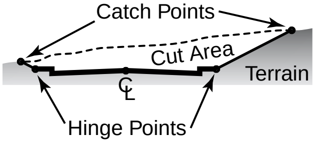
The ultimate purpose of the slope staking routine is to locate where the outer slopes of a predefined roadway intersects with the surface of the terrain at various stations so the point where a cut or a fill begins can be determined. This intersecting point is called the *catch point*.

Before a road can be slope staked, it must first be designed. The first step to designing a road is to define the path of the road's centerline. This line can be in the form of a polyline or an alignment. Creating these lines is explained in detail, starting on Page 38.

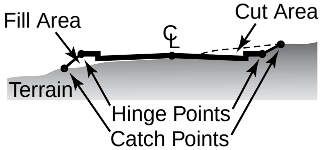
Once the centerline is defined, the cross-sectional profile of the road must be defined. This profile is then superimposed onto the centerline at a specified station interval. The final step is to go out in the field and stake the catch points at each of these stations.



A road requiring a fill on both sides.



A road requiring a cut on both sides.



A road requiring a fill on one side and a cut on the other side.

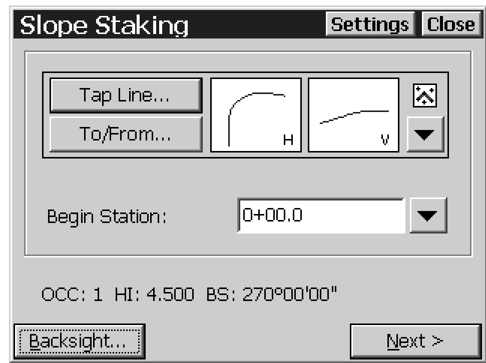
A road's cross sectional profile always consists of left and right road surfaces, which are tangent at the centerline. An optional curb or ditch can also be included in the road profile. The final segment of a road's profile has either a specified positive slope or a specified negative slope, which ends at the catch point. This final segment attaches to the edge of the road at what is called the *hinge point* since this segment can hinge between a positive and negative slope around this point.

The Slope Stake routine can automatically determine if the outer slope of the road profile should have a positive or a negative slope based on the location of the hinge point. If the hinge point is located below the surface of the terrain, a positive slope is selected and a cut will be required, starting at the catch point. If the hinge point is located above the surface of the terrain, a negative slope is selected where a fill will be required, starting at the catch point.

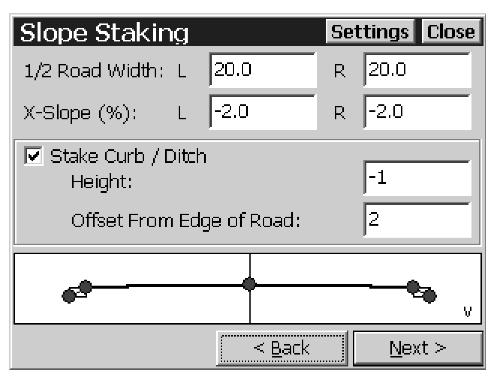
The illustrations here show examples of a road that requires a fill on both sides; a road that requires a cut on both sides; and a road that requires a fill on one side and cut on the other side.

It is important to remember that when slope staking a road, the road profile always remains the same and the slope of the final segment can only equal the specified positive (cut) slope, or the specified negative (fill) slope, but the length of this final segment can vary as much as necessary until it ends at the surface of the terrain (the catch point).

Defining the Road Cross-Section



1. From the Main Menu select [4 Stakeout], [E Slope Staking]. You will need to select a line that defines the centerline of your road. If one is not already created, refer to Page 38 for details on creating polylines and alignments.
2. Tap the [Tap Line] button and then tap the polyline or alignment that describes the centerline of the road you want to slope stake and then tap [OK] to continue.
3. Enter the station that you want to assign to the starting point of your alignment or polyline in the Begin Station field.
4. If the backsight is not yet set up, tap the [Backsight] button and set up the backsight. Tap [Next] to continue.
5. Enter the horizontal width of the left and right sides of the road in the 1/2 Road Width fields. These widths do not have to be the same.
6. Enter the cross-slopes of each side of the road in the X-Slope (%) fields.

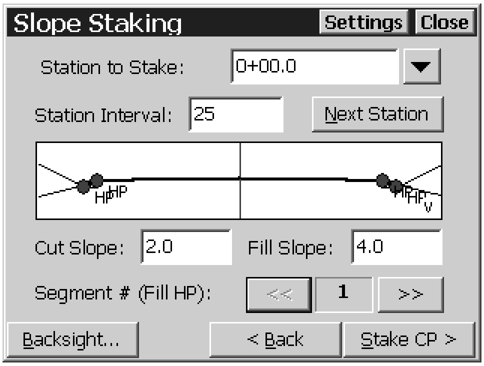


Note: A negative X-Slope value will result in a slope where water runs from the centerline of the road toward the edge.

7. If the road profile also includes a curb or a ditch, check the Stake Curb / Ditch checkbox and define the curb or ditch as follows.
8. If defining a ditch enter the depth of the ditch as a negative value in the Height field. If defining a curb, enter the height of the curb as a positive value in the Height field.
9. Enter the horizontal width of the curb or ditch in the Offset From Edge of Road field.

Note: You can tap in the graphic portion of the screen to open the graphic in a larger window.

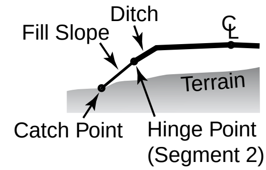
10. Tap Next > to continue to the next screen.



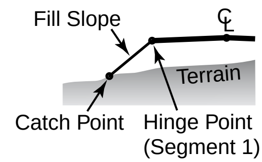
11. Enter the first station that you want to stake in the Station to Stake field. This station will be referenced from the Begin Station, assigned to the starting point of the centerline earlier.
12. Enter the distance between each station that you want to stake in the Station Interval field.
13. Enter the Fill Slope and Cut Slope in the respective fields. These slopes will be used to compute the location of the catch point for either cut or fill situations.

14. The Segment # (Fill HP) field is used to select which segment to compute the slope from in a fill situation. This is useful when your road profile includes a ditch and you are staking an area that requires a fill. In this situation, the ditch would not be necessary so you have the option to compute the slope from Segment 1. (See illustration.)

15. Tap Stake CP > to begin locating the catch points.



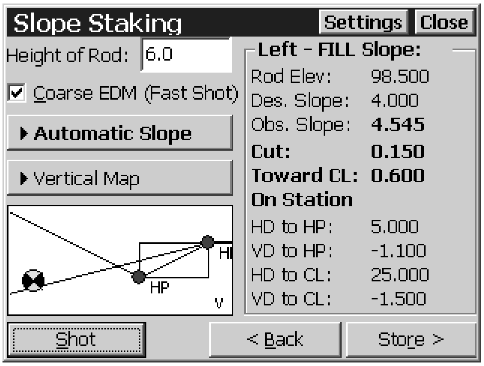
A road with a ditch requiring a fill and the hinge point is at Segment #2.



A road with a ditch requiring a fill and the hinge point is at Segment #1. (The ditch is ignored.)

Staking the Catch Point

16. If the first button is set to Automatic Slope (recommended), a cut slope will automatically be selected if the hinge point is located below the surface of the terrain and a fill slope will be selected if the hinge point is above the terrain. You can also force the computed values to be based on a cut slope or fill slope by tapping the button until it reads Force CUT Slope or Force FILL Slope respectively.



17. The second button is used to toggle which information is displayed in the lower corner of the screen. You can select Vertical Map, Horizontal Map, or Shot Data.

Note: You can tap in the graphic portion of the screen to open the graphic in a larger window.

18. With the rod in the general location of the first catch point that you want to stake, aim toward the prism and tap Shot. The distance and direction information will be computed and displayed along with other information pertaining to the shot. The routine automatically determines if you are staking the left or right catch point by the proximity of the rod.

Des. Slope is the design slope of the nearest cut or fill slope when Automatic Slope is selected, otherwise it is the design slope of the selected slope.

Obs. Slope is the observed slope of the terrain at the current rod location computed from the last shot and the corresponding hinge point.

Cut / Fill is the amount of cut or fill necessary for the rod to be on the design slope from the current rod location. If this value is zero, you have located the catch point, provided you are on the correct station.

Away (CL) indicates that the rod must move the specified horizontal distance away from the centerline (perpendicular to the centerline and parallel to the current station) to locate the catch point. Likewise, Toward CL indicates that the rod must move toward the centerline by the specified distance.

On Station indicates you are properly aligned on the current station. Back Sta indicates that the rod must move back toward the start of the alignment (parallel to the centerline) by the specified distance to be properly aligned over the current station. Likewise, Ahead Sta indicates that the rod must move away from the start of the alignment to be positioned over the current station.

The remaining information displays the horizontal and vertical distances to the hinge point and centerline from the current rod location.

Note: All previous shots taken while locating a specific catch point are shown in the map view as large X's. These can be useful in determining a situation where there is no catch point. (The slope never intersects with the surface of the terrain.)

---

19. Once the catch point is satisfactorily located and staked, tap Store >.

20. Enter a Point Name and Description in the corresponding fields and tap Store CP.

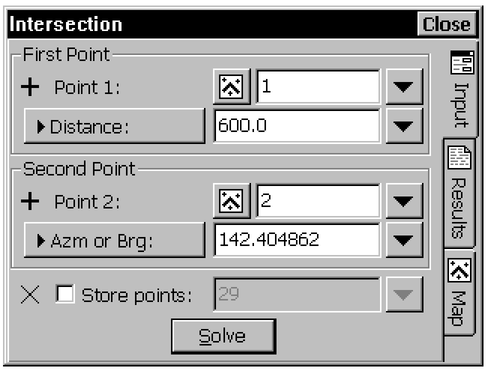
    You can optionally stake a location at a specified horizontal offset from the catch point (away from the centerline) by entering the offset distance in the Offset from CP field and tapping Solve >. This will open a new screen where the offset point can be staked like any other stake point.

21. Tap Next CP >. You will be prompted if you are done staking points for the current station. If you tap Yes, you will return to the third slope staking screen where you can then tap the Next Station button and advance the Station to Stake by the Station Inteval and begin locating your next catch point.

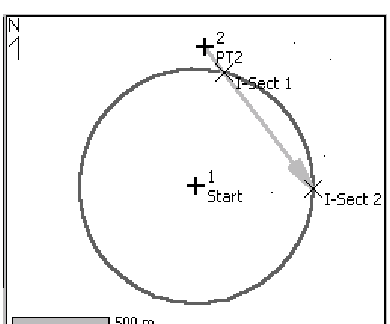
Intersection

The Intersection screen computes and optionally stores the coordinates for the intersection of two lines that are tangent to existing points.

Each line is independently defined by a known direction or a known length. In the situation where there is more than one possible solution, each solution is provided and optionally stored.



1. From the Main Menu, select [6 Cogo], [B Intersection].
2. In the Point 1 field, enter the point name that is tangent to the first line that intersects with the other line.
3. Toggle the first button to [Distance] or [Azm or Brg], depending on if the first line intersects at a known distance from Point 1, or at a known direction from Point 1, respectively.
4. In the same way that you defined the first line, define the second line tangent to Point 2 in the Second Point section of the screen.
5. If you want to store the intersecting point(s) that are computed from the routine, check the Store Points checkbox and specify a point name in the same field. If there is more than one solution, the additional points will be stored with the next sequential point name.



6. Tap [Solve] to compute the intersecting points. You can view the point's coordinates by tapping the [Results] tab and see a graphical representation of the intersections by tapping the [Map] tab.

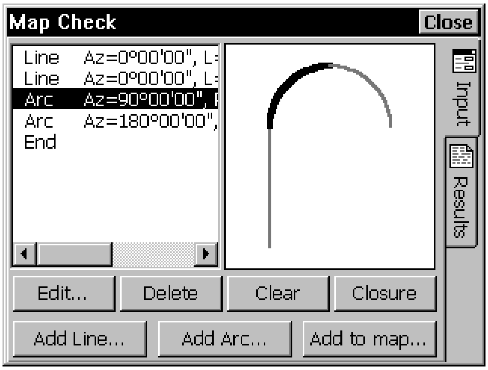
The map shown here illustrates a situation where two intersections were computed from a line with a known length tangent to Point 1 and a line with a known direction tangent to Point 2.

Map Check

The Map Check screen is used to enter distance and direction information from a map for straight and curved sections to compute closure, and other information from the entered boundary.

Entering Boundary Data

Each straight and curved section of the boundary is entered using the Add Line... and Add Arc... buttons in the order that the sections occur on the map.



1. Tap 6 Cogo, H Map Check.
2. To add a straight section, tap the Add Line... button to open the Add/Edit Line screen.
3. Toggle the Azimuth / Bearing button to the desired setting and then enter the direction in that field.
4. Enter the length of the straight section in the Length field and tap OK.

When you return to the Map Check screen, the straight section is displayed in a map view in the right-hand portion of the screen, along with any previously entered sections.

1. To add a horizontal curve to the boundary, tap the Add Arc... button
2. Describe the curve in the Add/Edit Curve screen.
3. Tap OK when finished.

Each section is added to the end of the previous section until all the sections are entered. When you are finished, you can view the details of the entered boundary by tapping the Results tab. You can also merge the entered data with the current project, described later.

Editing Boundary Data

Any entered section can be modified if an error is discovered. To edit a particular section, select the section from the left-hand portion of the screen and tap the Edit... button. The details of the selected section will open in the same editor that was used to create it. Simply make the necessary changes and tap OK.

Adding Boundary Data to the Current Project

You can add the boundary data that was entered to your current project. Points will then be created for the ends of each section that was entered and the line for the boundary is stored as a polyline.

The polyline can be used in any routine that supports them such as Inverse Point to Polyline, Edit Lines, Computer Area, etc.

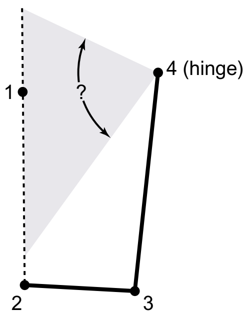
1. To add the boundary data to the current project, tap the Add to map... button.
2. In the Description field, enter the desired name for the polyline that will be stored.
3. Define the location of the beginning of the first section that defines your boundary.
    - To specify a new location, tap the Use Location> button and enter the appropriate northing, easting and elevation.
    - To specify an existing location, tap the Use Point> button, and enter the point name in the same field. (Alternatively, you can tap the  button and then tap on a point from the map view.)
4. Enter a name for the initial stored point in the Store points field. Each new point that follows will automatically be stored with the next available consecutive point name.

Predetermined Area

The Predetermined Area routine will take a boundary with one open side and compute the location of a line that will enclose a boundary with a specified area.

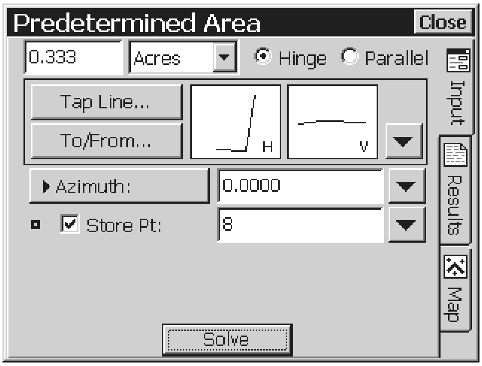
Two methods are available for computing a predetermined area, the Hinge Method and the Parallel Method. Each method is explained below.

Hinge Method



The Hinge Method computes the location of a side of a boundary that has one fixed point. The fixed point acts as a hinge where the computed side can pivot.

For example, assume you have four points that define an open boundary and you want to use the Hinge Method to compute the location of the final side of the boundary so that the entire boundary encloses a 1/3-acre lot and the fixed point (the location of the "hinge") is point 4, as shown here. The computed boundary line will fall somewhere in the gray area when the lot is equal to 1/3 acre.



1. Select [6 Cogo], [I Predetermined Area] from the Main Menu.
2. In the upper-left corner, enter the desired area (0.333-acres in this example) and select the Hinge radio button.
3. Tap the [Tap Points] button and then tap the points in the map view in the order that they occur in the boundary. (You would tap 2, 3, 4 in this example to define the two fixed boundary sides.)

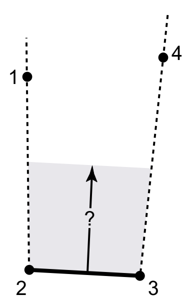
Note: The boundary can have as many points as you desire, but the selected points must begin with the starting point of the fixed line that the hinge line intersect with and end with the hinge point.

4. Check the Store Pt 1 checkbox and specify a point number in the same field if you want the endpoint of the computed line to be stored.

5. Enter the direction of the left side of the boundary in the last field. In this example, you should use the power button, and select Choose from map… and then tap points 2 and 1. The direction from point 2 to point 1 will then be automatically entered in the last field.

6. Tap Solve. The final boundary side will be computed and the data can be viewed by using the Results and Map tabs. If you selected to store a point in Step 4, the computed point will also be stored (Point 8 in the illustration shown here).

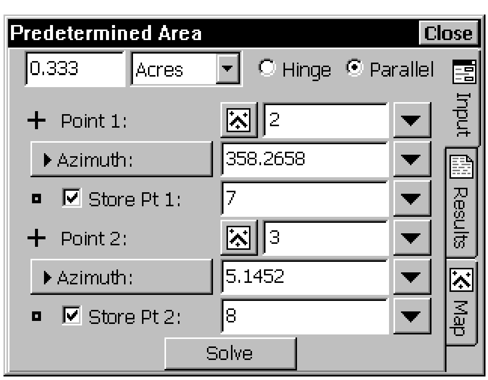
Parallel Method



The Parallel Method computes the location of one side of a four-sided boundary where the computed side is parallel to a stationary side of the boundary.

Using the same lot as we used above, we will compute the location of a line in a 1/3-acre boundary that is parallel to line 2-3 and intersects with line 2-1 and 3-4 as shown here.

1. Tap 6 Cogo, I Predetermined Area from the Main Menu.



2. In the upper-left corner, enter the desired area (1/3 acre in this example) and select the Parallel radio button.

3. Enter the first point that defines the fixed side of your four-sided boundary in the Point 1 field and the second point in the Point 2 field. (The computed side will be parallel to the line between these points.)

4. Define the directions of the two sides of the boundary that will intersect with the endpoints of the computed line. For this example, you would tap the power button, associated with each direction, select Choose From Map… and then tap points 2 and 1 for the first direction, and 3 and 4 for the second direction.

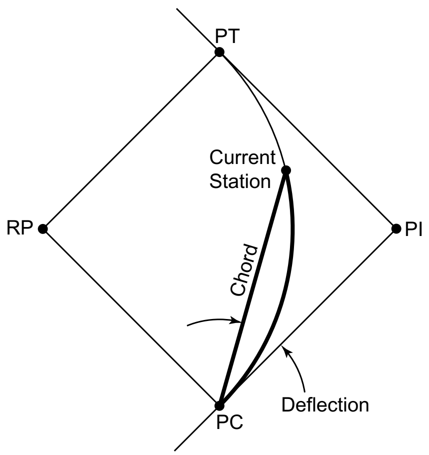
5. If you want to store points where the computed line intersects with the two sides, check each Store Pt box and specify point names in the corresponding fields.

6. Tap Solve. The final boundary side will be computed and the data can be viewed by using the Results and Map tabs. If you selected to store points, the computed points will also be stored.

Horizontal Curve Layout

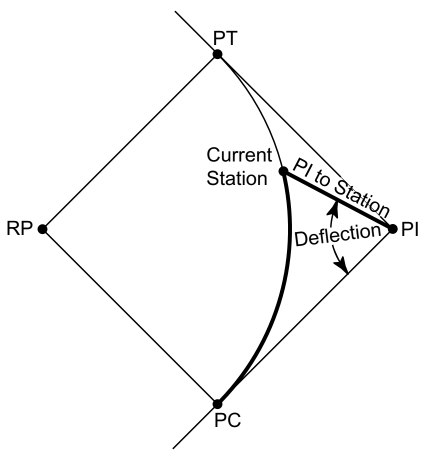
The Horizontal Curve Layout screen is useful to compute the locations of any station along a horizontal curve using one of four different methods. The values computed can be written down and used to later stake those stations in the field.

1. Tap [7] Curve, [F] Curve Layout from the Main Menu.
2. Select the method that you want to use to compute your curve layout data in the Method field. Each method is described below.



PC Deflection

The PC Deflection method computes a chord length from the PC to the current station and a deflection angle between the PC-PI line and the chord.

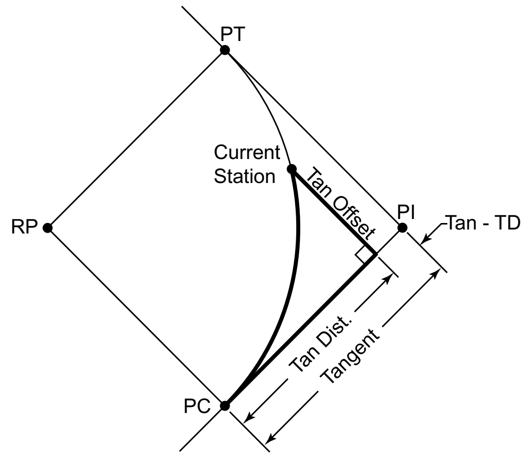


PI Deflection

The PI Deflection method computes the distance from the PI to the current station and the deflection angle between the PI-PC line and the PI to Station line.

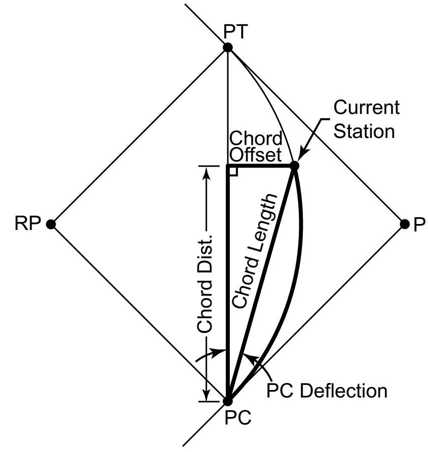
Tangent Offset

The Tangent Offset method computes a perpendicular offset length (Tangent Offset) from the PC-PI line to the current station and the distance on the PC-PI line from the PC to the Tangent Offset (Tangent Distance).



Chord Offset

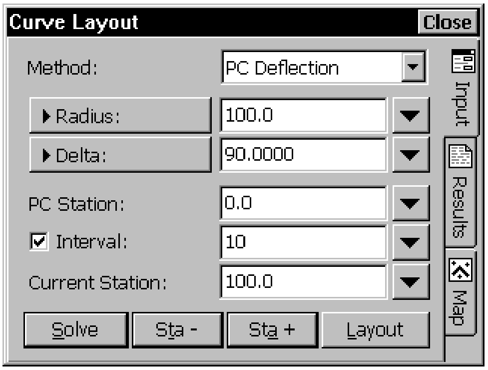
The Chord Offset method computes a perpendicular offset length from the PC-PT line to the current station (Chord Offset), the distance on the PC-PT line from the PC to the chord offset (Chord Distance), the distance from the PC to the current station (Chord Length) and the deflection angle from the PC-PT line to the PC-Station line.



3. Define your horizontal curve by making the appropriate selections from the first two buttons and filling in the corresponding values.

4. Enter the station to be assigned to the PC in the PC Station field.

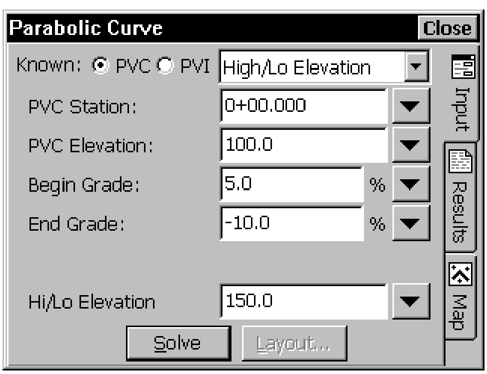
5. Check the Interval box if you want to compute data for stations at fixed intervals on the curve and enter the distance between them in the same field.



6. Enter the station that you want to compute in the Current Station field and tap Solve.
7. Tap the Results tab to view the numerical information for the location of the current station. Tap the Map tab to view a graphic of the current station on the curve.
8. Tap Sta + to advance the current station by the specified station interval or tap Sta - to subtract the station interval from the current station.

Parabolic Curve Layout

The Parabolic Curve Layout screen is useful to compute the locations of any station along a vertical curve when two parts of the curve are already known. The values computed can be written down and used to later stake those stations in the field.



1. Tap 7 Curve, H Parabolic Curve from the Main Menu.
2. In the Known field, select if the station and elevation for the PVC or the PVI are known by selecting the appropriate radio button. Also specify if the Curve Length, Point on Curve, or High/Lo Elevation is known from the dropdown list. (The remaining information that must be entered will vary depending on the choice made here.)
3. Fill in each field with the remaining information that pertains to your parabolic curve and tap Solve.

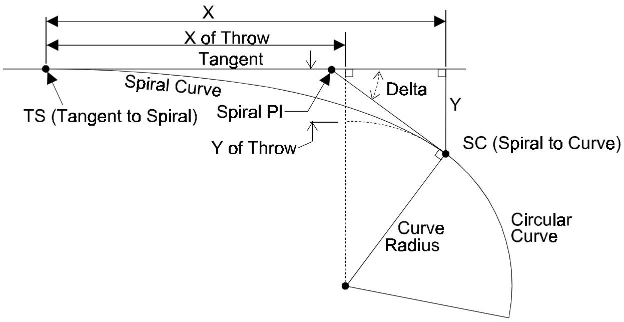
Note: The length of a parabolic curve is the horizontal distance from the PVC to the PVT.

Note: The horizontal distance from the PVI to the PVC always equals the horizontal distance from the PVI to the PVT

Spiral Layout

A spiral curve is a special curve that has a specified radius at one end, which gradually changes to an infinite radius at the other end. It is commonly used as a transition between a straight section and a circular curve.

The Spiral Layout screen is used to calculate the pertinent parts of a circular curve after specifying the spiral curve's radius and length.

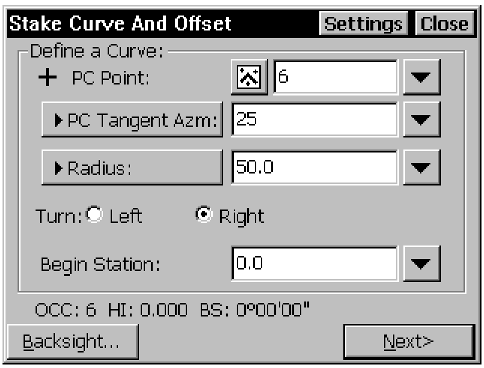


1. Tap [7 Curve], [K Spiral] from the Main Menu.
2. Enter the radius of the spiral curve in the Curve field.
3. Enter the length of the spiral curve in the Length field.
4. Tap [Solve]. The details of the specified spiral curve can be viewed by tapping the Results and Map tabs.

Curve and Offset

The Curve and Offset screen allows you to design a curve and stake it in the field. You can stake the curve's centerline or an offset to the curve at any specified station interval.

Define Your Curve



1. Tap [4 Stakeout], [G Curve and Offset] from the Main Menu.
2. If you have not yet setup your backsight, tap the [Backsight...] button and set it up.
3. Specify the point that you will use for the PC of your curve in the PC Point field.

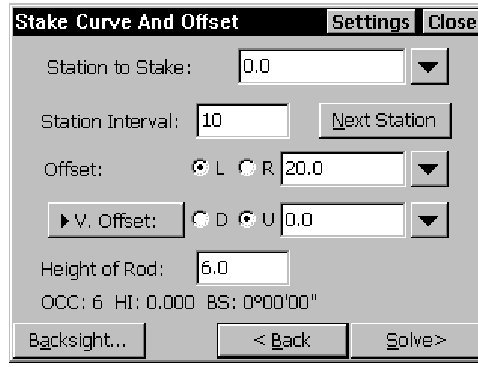
Tip: You can use the power button, [▼] to select a point from your map.

4. Define the direction of the tangent azimuth at the PC of your curve by selecting [▸ PC Tangent Azm] or [▸ PC Tangent Brg] and enter the appropriate value in this field.
5. Define the size of the curve by selecting [▸ Radius], [▸ Degree Arc], or [▸ Degree Chord] and enter the appropriate value in this field.

Note: Since the length of the curve is not required, you can potentially stake a 360º curve.

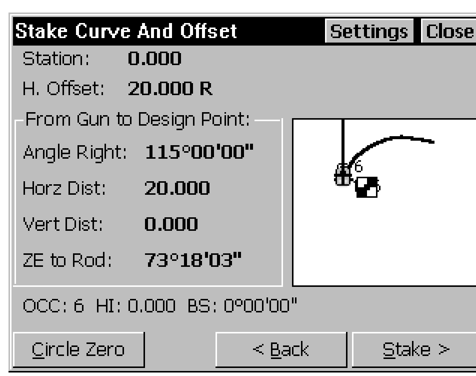
6. Select the radio button that defines if the curve turns toward the ◉ Left or ◉ Right as you view the curve from the PC.
7. Enter the station that you want to assign to the PC in the Begin Station field. (This value is typically zero.)
8. Tap [Next>] to continue.

Setup Your Staking Options



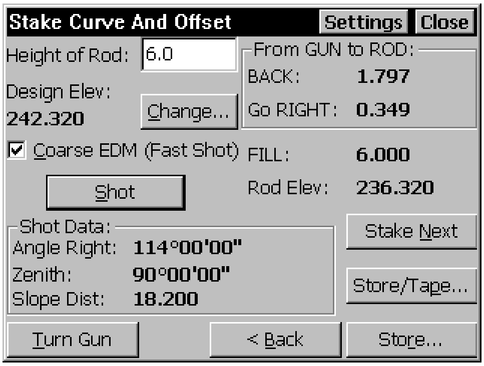
9. Enter the first station that you want to stake in the Station to Stake field.
10. Enter the desired spacing between the staked stations in the Station Interval field.
11. In the Offset field, select L if you wish to stake an offset on the left side of the curve, or select R if you wish to stake an offset on the right side and enter the desired offset here. (If you are not staking an offset, enter an offset of zero.)
12. Tap the ▸V.Offset / ▸Grade button if you want to account for a vertical offset or percent grade for the staked points and enter the appropriate valued in the same field. When specifying a vertical offset, you must also select the D or U radio button to indicate if the specified offset is downward or upward from the design point, respectively.
13. Enter the current rod height in the Height of Rod field and tap Solve>.

Aim the Total Station



14. Using the information displayed on the screen, aim the total station toward the design point and tap Stake >. The graphic portion of the screen shows the curve, backsight direction and design point location relative to the total station.

Stake the Point

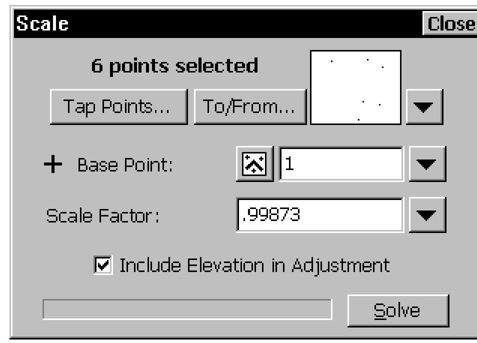


15. The final screen allows you to stake the current station. With the rod positioned where you want it, tap the Shot button to take a shot. If necessary, move the rod and take another shot until it is over the design point.

16. Tap the Store button to save the stake point. You will automatically be returned to the second screen (Step 9) where you can then tap the Next Station button to advance the current station by the station interval and stake the next point.

Scale Adjustment

The Scale routine will adjust the coordinates of selected points by a specified scale factor relative to a base point. This is useful to repair data that was collected where an incorrect scale factor was applied.

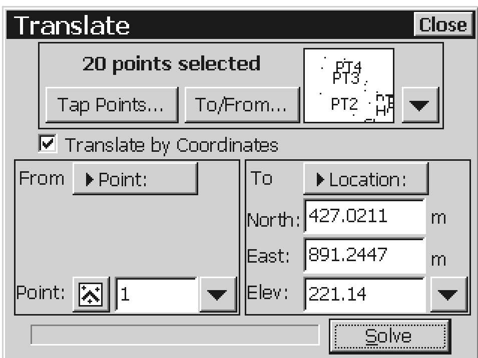


1. Tap [9 Adjust], [A Scale] from the Main Menu.
2. Use the [Tap Points...] or [To/From...] button to specify the points that you want to adjust.
3. Enter the name of the base point in the Base Point field.
4. Specify the scale factor to apply in the Scale Factor field.
5. If you also want to adjust the elevations of the selected points, check the Include Elevation in Adjustment checkbox.
6. Tap [Solve]. The coordinates for the selected points will be adjusted.

Note: If you choose to also scale elevations, the scale factor will be applied to the difference in elevation between the base point and each selected point. For example, if the base point elevation was 100 and the elevation for a selected point was 150, applying a scale factor of 0.5 would result in an elevation of 125 for the selected point.

Translate Adjustment

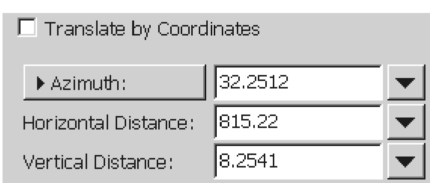
The Translate routine will move points horizontally and/or vertically a specified distance and direction. This routine is often used after a survey was performed in an assumed coordinate system. If the actual coordinates for at least one of the points is found later, the Translate routine can be used to shift all of the affected points to the correct coordinate system and/or elevation.



1. Tap 9 Adjust, B Translate from the Main Menu.
2. Use the Tap Points... or To/From... button to select the points that need to be adjusted.
3. Define the direction and distance for the adjustment using either of the following two methods:

Translate by Distance and Direction

The Translate by Distance and Direction method simply requires that you enter the distance and direction to adjust the selected points.



- Leave the Translate by Coordinates checkbox **un**checked.
- Toggle the Azimuth / Bearing button to the desired format and enter the direction to adjust the selected points.
- Enter the horizontal distance to adjust the selected points in the Distance field.
- Enter the elevation to adjust the selected points in the Elevation field.

- Tap Solve. The selected points will be adjusted by the direction and distance entered.

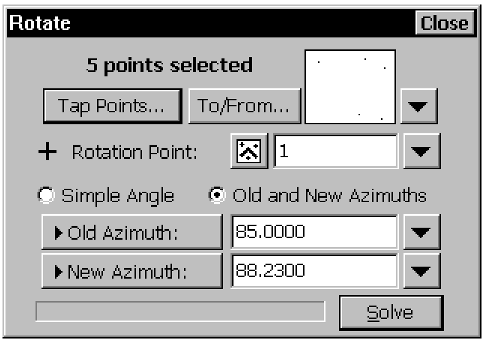
Translate by Coordinates

The Translate by Coordinates method requires that you define a starting location and an ending location. The adjustment will then move all of the selected points in the direction and distance as defined between the starting and ending locations.

- Check the Translate by Coordinates checkbox.
- Tap the From tab and enter the starting location by tapping the ▸Point / ▸Location button and either specify an existing point name or enter coordinates.
- Tap the To tab and define the ending location in the same way as you did above.
- Tap Solve. The selected points will be adjusted in the same direction and distance as between the starting and ending location.

Rotate Adjustment

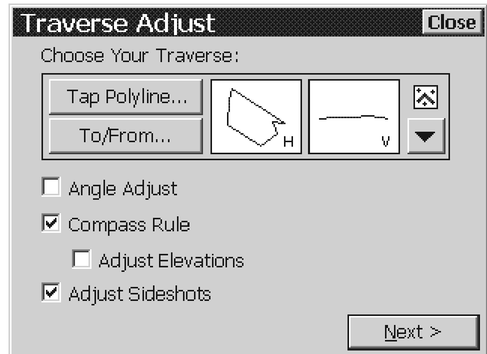
The Rotate Adjustment routine will rotate selected points around a specified rotation point.



1. Tap 9 Adjust, C Rotate from the Main Menu.
2. Use the Tap Points... or To/From... button to select the points that need to be rotated.
3. Enter the point that the selected points will rotate around in the Rotation Point field.
4. Select a radio button for one of the following rotation methods:
   - If you select Simple Angle, simply enter the rotation angle in the appropriate field.
   - If you select Old and New Azimuths, enter an Old Azimuth and New Azimuth in the appropriate fields. (The rotation angle used is the computed angle from the old azimuth to the new azimuth.)
5. Tap Solve. The selected points will be rotated around the rotation point by the specified angle.

Traverse Adjust

The Traverse Adjust wizard will perform an angle adjustment, a compass rule adjustment, or both.

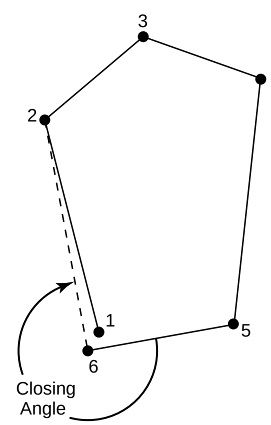


Angle Adjust

The Angle Adjust routine will compute the angular error in a closed traverse from a known closing angle. It will then distribute that error equally among all of the internal angles so that the resulting sum of the angles will equal (N–2)·180° because the sum of the internal angles of any closed polygon can be computed using this formula, where N is the number of sides of the polygon.

After performing an angle adjustment, all of the points except for the first two points will be adjusted. (The azimuth of the first leg will remain constant.)

The closing angle provided is used to compute the angular error. It is the angle as you occupy the closing point, aim toward the second point and turn an angle-right to the second-to-the-last traverse point (see illustration).



Note: An angle adjustment does not always adjust the closing point to a location that is closer to the starting point.

Compass Rule

The Compass Rule Adjustment will adjust either a closed or an open traverse. When adjusting a closed traverse, the error between the closing point and the initial point is computed and distributed among each traverse point, except the initial point resulting in a perfect closure. When adjusting an open traverse, the error between the final point's actual location and specified theoretical location is computed and distributed among the traverse points in the same way as with a closed traverse.

Typically the Angle Adjust option should also be selected to remove the angular when performing a compass rule adjustment.

Adjust Elevations

The Adjust Elevations option only applies when performing a Compass Rule adjustment. If this option is selected, the elevations for the adjusted points will also be adjusted along with the horizontal coordinates resulting in perfect closure vertically as well as horizontally. If this is unchecked, the traverse will only be adjusted horizontally.

Adjust Sideshots

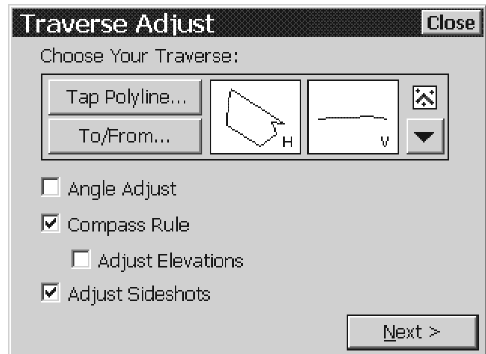
The Adjust Sideshots option allows you to also adjust any side shots that were stored while occupying any of the traverse points in the selected traverse.

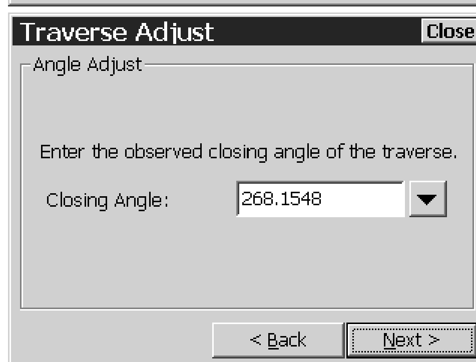
The side shots that will be adjusted are determined by the information stored in the raw data. Because of this, the end user cannot explicitly define which side shots to include or exclude from the adjustment.

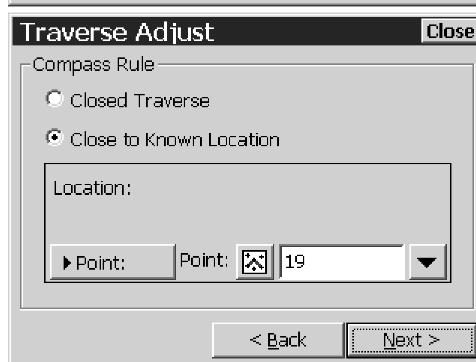
The side shots are adjusted by first computing the new locations of the traverse points, which are the occupy and backsight points for the side shots. The routine will then read the original angles and distances recorded for each side shot and apply those measurements to the adjusted locations of the appropriate traverse points.

Performing an Adjustment

1. Tap 9 Adjust, D Traverse Adjust from the Main Menu.
2. Use the Tap Polylines... or To/From... button to select the polyline or points that define your traverse, which should be in the same order that the traverse points were collected.
3. Select the appropriate checkboxes to define the type of adjustment(s) to perform and what will be adjusted.
4. Tap Next > to continue to the next screen. The screen that opens will depend on the selections made from the main screen.
5. If an angle adjustment is being performed, the screen shown here will open. Enter the closing angle for the traverse in the form of an angle-right.
6. Tap Next > to open the next screen of the adjustment wizard.
7. If a Compass Rule adjustment is being performed, the screen shown here will open. Select Closed Traverse if you are adjusting a closed traverse or select Close to Known Location if you are adjusting an open traverse and closing to a known point or location. A closing location can be defined by an existing point or known coordinates by toggling the ▸ Point / ▸ Location button accordingly.







*** Preview ***	
Adjustment Settings	
Angle Adjust	
Compass Rule	
Angle Adjust	
Original	
Error dist.	0.493
Error azm	126°28'02"
Precision	1:6609
Angular error	37°51'05.81"
Change per angle	-4°12'20.65"
Closing angle	261°30'00"
Length	3,255.484
Perimeter	3,255.976
Adjusted	
Error distance	333.416
Error azimuth	62°23'21"
Precision	1:9
Length	3,255.484
Perimeter	3,588.900
Compass Rule	
Closing to Known Location	
Location N	5,743.847
Location E	5,066.043
Location Z	230.810
Original	(After Angle Adjust)
Error distance	333.201
Error azimuth	62°18'47"
Precision	1:9
Length	3,255.484
Perimeter	3,588.900
Adjusted	
Error distance	0.000
Error azimuth	---
Precision	Perfect
Length	3,230.649
Perimeter	3,231.142
Point Details	
Traverse	18
First point is fixed	
Traverse	12
Original N	5,294.389
Original E	5,439.999
Original Z	246.320
Adjusted N	5,350.777
Adjusted E	5,524.881
Adjusted Z	246.320
Change N	56.388
Change E	84.882
Change Z	0.000
Linear change	101.905
Traverse	11

Note: if closing to a known location and a closing location is not specified, it is automatically assumed that the first point of the traverse will be the closing location.

8. Tap Next > to open the final screen of the adjustment wizard, which displays the changes that will be made by the adjustment where they can be previewed before the actual adjustment is applied.

   The screen lists the adjustment details in three main sections: the angle adjustment details; the compass rule adjustment details, and the point details where the before-and-after coordinates for each point are listed. An example of the information provided in this screen is shown here.

9. If you are satisfied with the changes that will be made by the adjustment routine, tap Adjust to perform the adjustment.